The Madras Agricultural Journal

1957 August

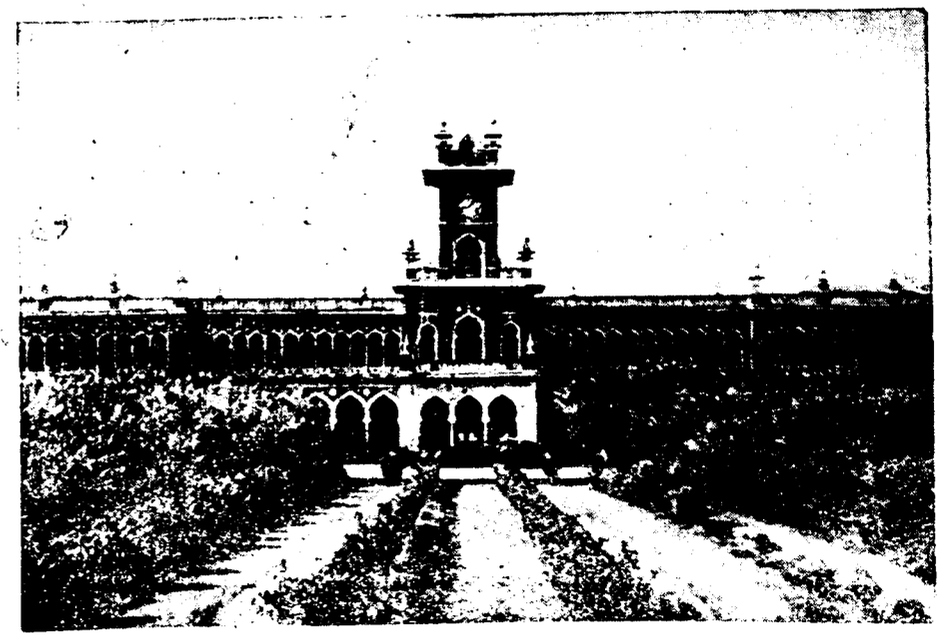
Vol. 44. No. 8.

Regd. No. M. 1155

THE

Madras Agricultural Journal

Vol. XLIV August 1957 No. 8



AGRICULTURAL COLLEGE AND RESEARCH INSTITUTE, COIMBATORE

Published by

THE MADRAS AGRICULTURAL UNION,
(M. A. S. U.)
AGRICULTURAL COLLEGE AND RESEARCH INSTITUTE
COIMBATORE, S. INDIA.

Annual Subscription.
Inland Rs. 6—0—0
Foreign Rs. 7—0—0

Single Copy
As. 8

The Madras Agricultural Union.

PATRONS.

1. [illegible]yam Bahadur C. Arunachala Mudaliar, Zamindar of Chunampet
2. Raja Sri Krishnachandra Gajapathi Narayana Dev, Maharaja of Parlakimidi
3. Sri V. C. Palaniswami Gounder, M. L. A., Vellaikinar, Coimbatore
4. ,, C. P. Ramaswami Ayyar, Ootacamund
5. ,, R. Jeevandass, Varnasi, Parlakimidi
6. G. R. Hilson Esq., Norwich, England
7. Sri Ramachandra Ananga Bhima Dev, Kesari Gajapathi, Raja Saheb of Budokhemidi, Berhampore, Ganjam
8. Rao Bahadur K. T. Alwa, Mangalore
9. Sri Gurdial Singh Sidhur, C/o Sri S. Sant Singh Sidhu, Algom Khurd, Lahore
10. ,, R. K. Kandaswamy, "Brindavan", Tiruchi Road, Coimbatore
11. ,, G. D. Naidu, "Gopal Bagh", Avanashi Road, Coimbatore
12. ,, K. Thiravenkata Mudaliar, Munniyur, Andankarai P. O., (Via) Alattambadi, S. R.
13. ,, S. Ramamurthy Iyer of Kunnam, Land-Holder and Secretary, South Rajan Mirasdars' Association, "Vibrajee", Alangad
14. ,, P. G. Karuthiruman, M. L. A., Nanjai Puliampatti, Thukkanaickanpalayam, (Via) Anthiyur
15. ,, K. Venkataswami Naidu, B. A., B. L., Gopalapuram, Coimbatore
16. ,, C. V. Bashyam, "Dharma Vilas", College Road, Coimbatore
17. ,, V. C. Subbaiya Gounder, Gnanambika Mills P. O., Coimbatore
18. ,, M. S. Palaniappa Mudaliar, 125, Rajah Street, Coimbatore
19. ,, A. K. D. Balaramaraju, Land-Lord, Rajapalayam
20. ,, N. S. Vydianatha Iyer, Sengalipuram, (Via) Kodavasal, Tanjore
21. ,, K. P. Amrithanatha Iyer, President, Co-operative Union Ltd., Ambalapuzha Taluk, Monkompu P. O., (T. C. State)
22. ,, M. Subba Reddy B. sc., (Ag.) Mango Range, P. O. Nilgiris
23. ,, M. R. Balakrishnan, F. A. O., Irrigation Agronomist, Thailand
24. ,, S. Raja Iyengar, Landlord and Agriculturist, Madurai
25. ,, K. Rangachari, Landlord, 16, Old Munsiff's Court Street, Saidapet, Vellore
26. ,, R. Ramakrishna Naidu, Palamalai Ranganathar Mills, Perianaickanpalayam
27. ,, C. M. John, Agricultural & Technical Adviser, The Potash Scheme, India, 7, Lavelle Road, Banglore-1
28. ,, S. N. Venkataraman, 33, Third Main Road, Gandhinagar, Madras - 20
29. Dr. T. S. Sadasivan, Director, Botany Laboratory, Madras University, Triplicane, Madras
30. ,, W. P. A. Soundira Pandian, Pattiveeranpatti, Batlagundu P. O., (Via) Kodai Road
31. ,, M. A. Ayee Gounder, Kasipalayam, (Via) Gobichettipalayam
32. ,, K. S. Vengu Chettiar, 'Kottachi House' Koranad, Mayuram
33. ,, V. P. K. Kayarohanam Pillai, Agriculturist and Businessman, Nagapattinam
34. ,, A. K. Subramania Odayar, Mirasdar, Attur Village, Nannilam Taluk
35. ,, R. V. Sundara Reddiar, B. A., B. L., Advocate, Benshana Vilas, Cuddalore
36. ,, N. M. Rajaram Reddiar, Nathapet P. O., Cuddalore
37. ,, M. Arunachalam, C/o. Sri Muthurama Reddiar, Pangamadai Village P. O., (Via) Panrutti
38. ,, S. D. Rama Reddiar, Purnasugaipalayam P. O., (Via) Pallianellur, Villupuram
39. ,, S. Kothandapani Pillai, Purnasugaipalayam, (Via) Pallianellur, Villupuram

The Madras Agricultural Journal

Vol. XLIV AUGUST 1957 No. 8

CONTENTS

The Madras Agricultural Journal

Vol. XLIV **August 1957** **No. 8**

Editorial

MAN has been living on the produce from the soil of the world. The patterns for raising food and industrial raw materials have been many and varied. Agriculture was at a level of marginal production for centuries before the advent of modern science. Famines occured and a vast portion of the population continued to be underfed. In this background has come to us, the breath-taking and far reaching developments in agricultural technology. The last FIFTY YEARS coinciding with the life of the Agricultural College and Research Institute at Coimbatore have been the most significant in the development of agriculture the world has ever witnessed during the five thousand years of man's history of tilling the soil.

Research has been the key to better farming and the earliest attempts were directed towards evolving better and more efficient methods of cultivation. The use of iron ploughs and cultivators to efficiently and economically cultivate crops was one of the useful early developments. The use of machinery and mechanical power to substitute animal power was another forward step. The evolution of better varieties by crop breeders brought in great possibilities for increasing yields. Genetics contributed the technical 'know how' for the breeder to improve crop varieties for the production of bigger and better crops adapted to all environments.

The developments in our knowledge of plant nutrients and their production technology have been revolutionary. As a sure method for increasing crop yields, fertilisers now occupy a place of vital importance in the agricultural economy

of the world. Research on their use and methods of application has been yet another phase of agricultural progress. The chemical industry now provides a bewildering range of toxic pesticides and fungicides for the prevention and eradication of crop pests and diseases. The farmer has a more clear cut and assured method now to protect his crops.

Thus has agricultural research multiplied yields of crops, beaten famine and banished hunger for the fast growing populations. The Agricultural College and Research Institute have during the past FIFTY YEARS contributed in these amazing possibilities on the application of science in the field of crop production and laid the real foundations of agricultural progress of the country. We on this memorable occasion of the 'GOLDEN JUBILEE' convey our greetings and wish the Agricultural College and Research Institute many, many years of useful existence contributing to the welfare of MAN.

The Soils of Madras — Part - III
The Red Soils of Madras

71

by

P. K. R. MENON and Dr. A. MARIAKULANDAI,
Agricultural College and Research Institute, Coimbatore.

Introduction: In Part of I of the series (1) the distribution of the different soils in the state as a whole and in the various districts and taluks was described. In the second part (2) a fairly detailed description of the black soil of Madras was presented with data as to the mechanical composition, alkalinity, cation exchange properties and the fertility status of two of the important types. In the present paper the red soil of Madras including the red earths, lateritic and laterite soils are dealt with.

The broad basis for the revenue classification of soils are colour and texture and all soils with red colour are put into one group irrespective of their mineralogical and chemical composition. However, from a consideration of their properties and composition the red soils can be subdivided into two main categories: (1) the red earth with Kaolinitic clay and (2) the lateritic and laterite soils with a preponderance of hydrous oxide clay. The red soil is the most important soil in Madras in respect of area. It occupies 19 million acres (63% of the total cultivable area) as compared with less than 6 million acres of black soil.

Geology of the Red Soil: The main geological formations which have given rise to the red soils of Madras are the granites and gneisses of the Archean period. They cover extensive areas in the state. The rock formations are of a mixed character containing both acidic and basic components. The acidic part is rich in silica containing over 65% of the compound and with a molecular silica - sesquioxide ratio of over six. It is poor in lime but contains alkali felspars. It is generally the acidic component of granites and gneisses rich in alkali felspars which give rise to red soils on weathering. The other rock formations from which red soils have developed in Madras are the Cuddalore sand stones, mica schists, acid traps, quartzites, shales etc. On weathering, the alkali felspars present in these rocks form minerals of the Kaolinite group. These clay minerals become coated with red haematite or yellow limonite or a mixture of the two oxides of iron forming a red, yellow or a reddish - yellow soil. The yellowish soil becomes red when the limonite undergoes dehydration and changes to haematite.

Ferrugingeous gravel (impure iron, alumina and silica concretions) and bits of quartz are the common accessory constituents in red soils. Kankar or calcium carbonate is also found in some red soils. There are also instances where parent materials rich in calcium have given rise to reddish soil. For example, the limestone beds of Kurnool have developed into red soils. This is mainly due to the nature of the non-calcareous impurity in the limestone.

Except under extreme conditions as in the West Coast, climate has very little influence and the character of the parent material is the most important factor in respect of soil formation in Madras. In the West Coast and other regions with heavy rainfall of over 100 inches per annum and high summer temperature any rock formation can give rise to lateritic and laterite soils.

The Red Soil of Madras — General: The red variety is the most extensive soil type in Madras State and occurs in some form or other in all the districts. The largest areas are in Malabar and South Canara districts of erstwhile Madras and in the districts of Madura and North Arcot. It also occupies about 60% and more of the cultivable area in the districts of Chingelpet, South Arcot, Salem, Coimbatore, Tiruchirapalli, Tirunelveli etc. Tanjore and Ramanathapuram are the only localities where this soil type is not predominant. But in Tanjore district, the Cauvery alluvium is deposited over the red soil and so the native soil may be regarded as the red soil. Although complete data is not available for Nilgris, it is found that almost the entire area is covered with some variety of red soil. The red soil (including lateritic and laterite soils) is found in all rainfall regions from the semi-arid to the humid parts of the State.

The texture of the red soil varies from sands to clays. However, the majority are loams of some kind. The colour of the soil is due mainly to ferric oxides which occur as thin coatings on the soil particles. Where the iron oxide occurs as haematite or anhydrous ferric oxide the colour imparted is red. With limonite or hydrated ferric oxide the soil gets a yellowish colour and mixtures of the two oxides give different shades of red and yellow depending on which oxide predominates. Ordinarily the surface soil is reddish in colour and the lower depths may show a reddish-yellow or distinctly yellow colour because the dehydration of the iron oxides is generally greater in the surface layers.

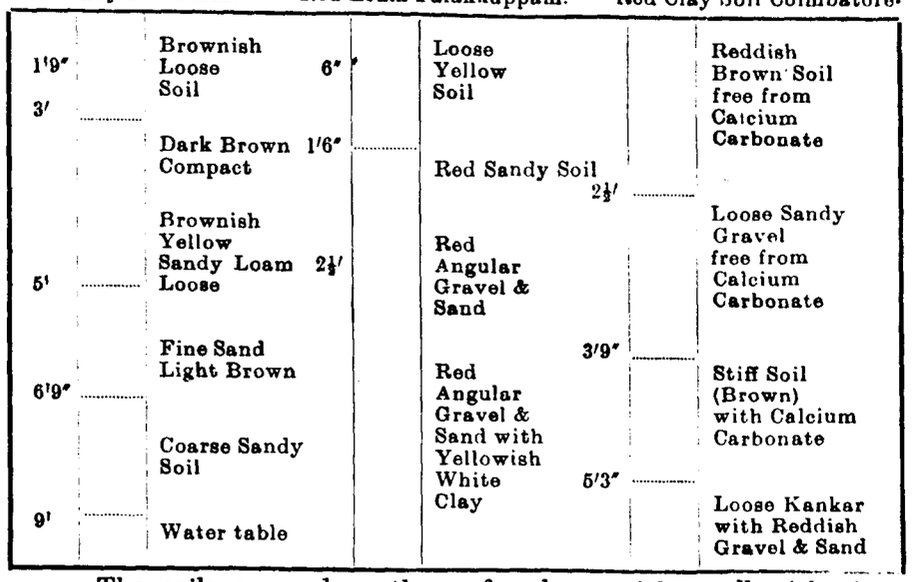
The characteristic clay mineral present in the soil is of the kaolinitic type and one gram of clay is approximately responsible for a cation exchange capacity of 0·25 to 0·5 milliequivalents. The base exchange capacity of the soil generally varies from 5 to 25 milliequivalents per 100 grams depending on the amounts of clay and organic matter. Calcium forms 40 to 70% of the exchange capacity. Acidic soils show lower content of exchangeable calcium while in the material of slightly alkaline soils it forms the major portion of the exchangeable cations. In the lateritic and laterite soils there is very little of silicate minerals. Even the coarser particles consist mainly of secondary products of weathering and there is a large proportion of hydrous oxides mixed with a little silica. Lateritic soils have, therefore, base exchange capacities varying from 4 to 7 milliequivalents per 100 grams of the soil while the values for laterites may be as low as 2 to 4 milliequivalents per 100 grams.

The red soil generally contains very low amounts of soluble salts (0·1% and less). The salts consist mainly of the bicarbonate, chloride and sulphate of sodium, calcium and magnesium. Soluble carbonates are seldom met with in the soils.

The red soils have a lower fertility status than the black soil. As is common with most of the tropical soils, organic, matter is generally much below the minimum requirement even where the total phosphoric acid is adequate. Potash, total and available, is present in the soils in good amounts except in the heavily leached lateritic and laterite soils. Most of the red soils of Madras contain enough of lime but there are some which would benefit by its application. This is particularly true of laterite and lateritic soils. The majority of the red soils are slightly on the acid side, while a few may be slightly alkaline, the pH ranging from 4·5 to 7·5. Although the nutrient content is low many crops can be successfully grown in the red soil with manuring on account of their favourable loamy texture.

As there is considerable variation in the minerological composition, the red soils can be studied under two main groups, namely the red earth and the lateritic soils including the laterites. The red earths contain Kaolinitic clay while the lateritic and laterite soils have mainly non-silicate hydrous oxides in the clay complex.

The Red Soil or the Red Earth: *Profile Characteristics:* The red earth vary considerably in texture. Some are sandy soils, most are loams of some kind and very few are clay soils. The profile descriptions of the true types are given below diagramatically:



The soils are red on the surface layer with a yellowish tinge in the lower depths indicating that the dehydration of the iron oxides is not complete below the surface. The sandy soil type contains a major part of the coarse fraction in all the depths while the loamy soil shows sand and gravel in the sub-soil and these are mixed with kaolin below the third foot. The sandy red soil and the loam do not contain much calcium carbonate in any of the depths but the clayey red soil of Coimbatore shows *Kankar* streaks below 2½ feet. The quantity of Kankar increases with depth and below 5 feet there is a considerable quantity of this material.

Mechanical Composition: The results of analysis of the soils for mechanical composition as carried out by the International A method without hydrogen peroxide treatment are tabulated below for the three types of red soil; sandy, loamy and clayey:

	Red Sandy Soil Palur		Red Loamy Soil Palakkuppam		Red Clay Soil Coimbatore	
	0–8"	8"–21"	0–6"	6"–18"	0–6"	6"–18"
Clay %	7·6	17·0	17·9	35·1	38·8	24·3
Silt %	6·5	7·3	2·1	3·4	14 6	6·3
Fine Sand %	44·4	41·8	28·0	21·2	20·8	24 3
Coarse Sand %	40 6	32·8	50·9	40·1	25·8	45·1
Matter soluble in dil Hcl. % etc. (By diff.)	0 9	1 1	1·1	0·2	...	...
Total	100·0	100 0	100·0	100·0	100·0	100·0

The Palur soil may be taken as typical of red sandy soil. The top soil contains less than 20% of the finer fractions and the sands are present in about equal proportions. The lower depth contains a higher percentage of clay probably as a consequence of leaching. The loamy soil of Palakkuppam is a loam only on the surface and becomes a clay in the lower depth containing twice as much of the fine particles. Coarse sand is found in both the soil and sub-soil in a larger proportion than fine sand.

The Coimbatore red soil is a clay soil only in the surface and becomes a clay loam in the lower depth. In the sub-soil there is a preponderance of coarse sand.

Water Soluble Salts: The results of analysis of water soluble salts in 1 : 5 soil exact are tabulated below for the three different types of red soil:

	Red Sandy Soil Palur		Red Loamy Soil Palakkuppam		Red Clay Soil Coimbatore	
	0–8"	8"–21"	0–6"	6"–18"	0–6"	6"–18"
Total Soluble salts %	0·040	0·063	0·040	0·014	0·025	0·025
Carbonate (CO_3) %	Nil		Nil		Nil	
Bicarbonte (HCO_3) %	0·013	0 017	0 018	0·0073	0·0026	0·0020
Chloride (Cl) %	0·0050	0·0070	0·0025	0·0025	0·0040	0·0035

The soluble salts are low in all the three soil types being less than 0·1%. This is, in the main, true of most red soils and carbonates are invariably absent. The most important ion in the soil extract is the bicarbonate with chloride closely following. The cations and the probable nature of the salts have not been determined as the total salt content is less than 0·1%. Monovalent cations (sodium and potassium) are generally more abundant in the soil extract of red soils than the divalent cations calcium and magnesium.

Cation Exchange Properties: On account of the Kaolinitic type of clay present in the red soil its base exchange capacity is much lower than that of the black soil: one hundred grams of the red soil clay possess a cation exchange capacity of only 25 to 50 milliequivalents. So, depending on the clay and organic matter contents, the exchange capacity of the soils in the field varies

considerably. The base exchange properties of the three types of red soil are tabulated below:

		Red Sandy Soil Palur		Red Loamy Soil Palukkuppam		Red Clay Soil Coimbatore	
		0-8"	8"-21"	0-6"	6"-18"	0-6"	6"-18"
Cation exchange capacity per 100 grams of soil		7·2	12·5	7·6	10 0	29 6	16 8
Exchangeable	Ca.	5·2	9 6	5·0	6·6	23·7	14·0
,,	Mg.	1·9	2·5	2·4	3·4	4·9	2·4
,,	K.	0·1	0·1	0·15	0·03	0·99	0·55
,,	Na.	..	0·2	..	..	..	..
		(Per 100 grams of soil)					

The cation exchange capacity and other exchange properties of the surface soil are invariably higher than can be accounted for from the clay content above. This is because of the organic colloids which are also present in the surface layer and which have 8 to 10 times the base exchange capacity of red soil clay. This is the reason for the comparatively higher exchange properties of the Palur sandy soil as compared with the loamy Palakkuppam soil. In Coimbatore surface soil also, organic matter has contributed to the exchange phenomenon and the cation exchange capacity is higher than what the mineral clay would show. In the cations of the exchange complex, calcium is the most important, forming 65 to 80% of the total. Next in importance is magnesium and potassium in the given order. Most of the red soils show little or no exchangeable sodium.

Fertility status: The red soil generally has a lower fertility status than the black soil. It is poorer in nitrogen, organic matter and available phosphoric acid. Some types of red soil do not also contain adequate amounts of calcium. Even though the red soils are lower in fertilty status than the black soils they can be adopted for the cultivation of a greater variety of crops on account of their loamy character or intermixture of the coarse and fine particles. The results of the chemical analysis of the three types of red soil are tabulated below. The total amounts of the nutrients were estimated in the hydrochloric acid extract prepared by disgesting the ignited soil with 1 : 1 hydrochloric acid in the ratio of 1 of soil to 3 of the acid mixture for 8 hours and filtering and washing. The available phosphoric acid and potash were determined by Dyer's 1% Citric acid method. Nitrogen (total) was estimated by digesting the soil with 1 : 1 sulphuric acid using reduced iron to bring into account any nitrate present in the soil.

Chemical analysis of red soils

		Red Sandy Soil Palur	Red Loamy Soil Palakkuppam	Red Clay Soil Coimbatore
		0—1'	0—1'	0—1'
Moisture		0·98	2·8	4·3
Loss on ignition %		1·71	3·19	4·19
Insoluble mineral matter %		91·49	85·34	78·70
Solubles (By. diff.)		6·80	11·47	17·11
	Total	100·00	100·00	100·00
Iron (Fe_2O_3)	Percent	2·09	6·21	5·31
Alumina (Al_2O_3)	,,	2·90	3·26	8·00
Lime (CaO)	,,	0·75	0·23	1·72
Magnesia (MgO)	,,	0·36	0·13	0·40
Potash (K_2O)	,,	0·24	0·13	0·61
Soda (Na_2O)	,,	0·07	0·061	0·30
Carbon dioxide (CO_2)	,,	..	0·032	1·17
Phosphoric acid (P_2O_5)	,,	0·0051	0·013	0 089
Sulphuric acid (SO_3)	,,	0·062	0·041	0·11
Nitrogen (N)	,,	0·033	0·028	0·056
Available Potash (K_2O)	,,	0·010	0·0063	0·019
Available Phosphoric acid (P_2O_5)	,,	0·00053	0 022	0·0022
Silica - Sesquioxide molar ratio $\left(\frac{SiO_2}{R_2O_3}\right)$		3·2	2·5	2·7
Silica - alumina molar ratio $\left(\frac{SiO_2}{Al_2O_3}\right)$		4·2	3·0	3·6
pH.		8·1	7 8	8·5

From the table it is seen that the red sandy soil has a low fertility status. It is poor in nitrogen and organic matter and in total and available phosphoric acid. Potash, both total and available are present in adequate amounts. There is a sufficiency of lime in the soil and calcium forms more than 70% of the cations in the exchange complex. Insoluble mineral matter constitutes more than 90% of the soil and iron and alumina are found in much smaller quantities than in other types of soil. The red sandy soil of Palur is on the alkaline side with pH value of 8.

The loamy red soil of Palakkuppam is also poor in nitrogen, organic matter and available phosphoric acid. In addition, it does not contain adequate amounts of calcium. However, potassium total and available and total phosphoric acid are present in the soil in sufficient quantities. The soil is on the alkaline side. Calcium constitutes about 65% of the exchangeable cations. The molecular silica sesquioxide ratio of the separated clay is typical of the Kaolinitic character of the red soil.

The clayey red soil of Coimbatore is more fertile than the other two types. It contains adequate amounts of nitrogen, total phosphoric acid, potash and lime. Available phosphoric acid and potash are also present in amounts more than the minimum required for plant growth. The soil contains free calcium carbonate as *Kankar* and calcium constitutes 80% and more of the cations in the exchange complex. The pH of the soil is about 8·5 without sodium carbonate. As is the common feature of the tropical soils, organic matter is not present in this soil in adequate amounts.

Lateritic and Laterite Soils: Although lateritic and laterite soils differ considerably from red soils in many important respects, they have been classified under red soils by the revenue authorities and so their characteristics are presented in this paper. They are generally developed in regions of heavy rainfall. Under conditions of heavy leaching due to rainfall, and high summer temperature, lateritic and laterite soils may be formed from any geological formation. But acidic rocks undergo these changes more readily than basic rocks. When large quantities of water percolate through the soil as in regions of heavy rainfall, the soluble salts are first washed out. Simultaneously and later on, the cations of the colloidal complex are gradually leached out, their places being taken by the hydrogen ions of the percolating carbonated waters. When the hydrogen ions in the exchange complex or colloidal complex exceed a certain limit they probely enter the clay micelle and break it up liberating iron and aluminium hydroxides and silicic acid. The silicic acid being soluble is gradually lost in the drainage waters and a matrix is left behind rich in iron and aluminium hydroxides and oxides and some silica. There may also be a small amount of Kaolinitic minerals but not much. Soils containing Kaolinitic clay also readily undergo laterization on account of heavy leaching. Strictly speaking the laterite thus formed cannot be called a soil but only as a degraded or decomposed soil material. There is not much of primary silicate minerals and even coarser particles consist chiefly of secondary products of weathering. The laterite is generally reddish or yellowish-red in colour and often has a vermicular structure with iron concretions. At or near the water table it is soft and can be cut out into blocks. These blocks dry up on exposure and become as hard as granite. So the material is quarried for use as bricks for building purposes. The material was given the name "laterite" from the latin term "later" meaning a brick. Latosol and Ferralite are two of the newer forms used to designate laterite soils.

Lateritic soils have not degenerated to the same extent as the true laterites. Here also there is the decomposition of the clay complex and the accumulation of iron and aluminium hydroxides. But the decomposition of only a smaller part of the colloidal complex has taken place and there is a slightly larger proportion of the primary Kaolinitic minerals than in laterites. Lateritic soils are therefore more fertile than the laterites.

Under the climatic conditions of South India, the amount and intensity of rainfall appear to be more potent in laterite formation than the temperature. Laterite soils are found extensively in the west coast and on the hills and in patches on the east coast. In Malabar these soils occur in all regions with an annual preciptation of over 100 inches concentrated in the South – West monsoon months of July August and September. In the extreme south of the district, in Palghat taluk the rainfall is less: it is only 70–80 inches per annum and it is distributed in the South – West and North – East monsoons (50 to 60″ in the South West and 20 to 30″ in the North East monsoons). The soils in this region have not developed into laterites: they are only lateritic in character. The lateritic soils do not have the vermicular structure peculiar to laterites. They cannot be used as building stones.

As the laterites do not contain primary clay minerals they show the typical clay properties such as plasticity, cohesion, shrinkage, expansion, base exchange properties etc., to a very small extent. Even a clayey laterite soil is highly porous and is not able to retain water and manures added to it. The base exchange capacity of the mineral colloids may range from 2 to 4 milliequivalents per 100 grams for laterites and from 4 to 7 for lateritic soils. The molecular silica-sesquioxide radio of laterite soils is below 1·33 and that of lateritic soils between 1·33 and 2.

Detailed Study of the Lateritic and Laterite Soils

PROFILE CHARACTERISTICS

Lateritic Soil, Pattukkottai.			Laterite Soil, Taliparamba.		
6″		Brown Sandy Loam	1′		Dark Red
		Buff Coloured Red loam Tending to be heavier downwards			Red in Colour with Vescicular Structure & Iron Concretions
3′		Brown Loam with Gravel (Iron Concretions) which increases with depth	6′		Yellowish Red
6′					

Mechanical composition of Lateritic and Laterite Soils:

	Lateritic Soil Pattukkottai		Laterite Soil Mangalore	
	0—6″	6″—12″	0—1′	1′—2′
Moisture %	0-61	0-81	1-80	1-92
Clay per cent	13·0	25·7	31·8	43·8
Silt ,,	2·5	2·6	14·3	16·5
Fine Sand per cent	22·7	17·7	9·8	9·5
Coarse Sand ,,	62·8	54·5	45·0	30·5

Water Soluble Salts: alkalinity in Lateritic and Laterite Soils

	Lateritic Soil Pattukkottai		Laterite Soil Mangalore	
	0—6″	6″—12″	0—1′	1′—2′
Total Soluble Salts %	0·01	0·01	..	..
Carbonate (CO_3)	not estimated		nil	nil
Bicarbonate (HCO_3)	..	..	0·0031	0·0024
Chloride (Cl.)	..	..	0·021	0·013

Base Exchange Properties of Lateritic and Laterite Soils

	Lateritic Soil Pattukkottai		Laterite Soil Mangalore	
	0—6″	6″—12″	0—1′	1′—2′
Cation exchange capacity m. e. per 100 grams of Soil	2·4	3·6	7·9	1·2
Exchangeable Calcium m. e. per 100 grams of Soil	1·3	1·9	1·7	1·2
Exchangeable Magnesium	0 8	1·5	1·1	1 0
,, Potassium	0·3	0·2	0·2	0·1
,, Sodium	0·02	0·1	..	..
Degree of alkalinisation %	12·5	6·3	..	..

Fertility Status of Lateritic and Laterite Soils:

	Lateritic Soil Pattukkottai		Laterite Soil Mangalore	
	0—6″	6″—12″	0—1′	1′—2′
Moisture %	0·61	0·81	1 80	1·92
Loss on ignition %	1·23	2·56	7·74	9 08
Lime (Ca O) %	0·049	0·063	0·042	0·049
Total Nitrogen % (N)	0·020	0·023	0·068	0·020
Total phosphoric acid (P_2O_5)	0·0081	0·024	0·095	0·022
Total Potash (K_2O)	0·19	0·21	0·19	0·12
Available phosphoric acid (P_2O_5) %	0·0013	0·0011	0·0021	0·00053
Available Potash (K_2O) %	0·01	0·008	0 011	0 007
Organic carbon (Walkley and Black Number)	0·20	0·12	0 32	0·24
Silica sesquioxide $\frac{SiO_2}{R_2O_3}$ molar ratio	..	..	1·32	1·33
$\frac{SiO_2}{Al_2O_3}$ molar ratio	..	..	1·67	1·75
pH	6·80	7 05	4·8	4 9

Profile characteristics: The soils are often deep; the lateritic soil in some localities,' however are shallow. The lateritic soil generally is some kind of loam in the different horizons without the vescicular structure characteristic of the true laterites. Both clays and loams are noted in the laterite type, with over 50% of clay particles in some localities. Both the soils are red on the top and the colour changes to reddish yellow and finally to yellow in the deeper layers. Ferrugineous gravel is met with in both the soil types in some part of the profile. At and below the water table the laterite is soft and cheesy.

Mechanical composition: The lateritic soil is often a loam of some kind with good internal drainage. The percolating waters carry down some of the finer particles. This is why the lower depth in Pattukkottai contains about twice as much clay as the surface soil. The coarser fractions form about 80% of the surface soil and the sub - soil, with coarse sand preponderating.

The laterite soil is a clay soil in both the depths. Here also there is a considerable washing down of the finer particles into the sub - soil. Both the soil and the sub - soil contain about equal amounts of the finer and the coarser fractions. The sub - soil, however, is richer in finer particles.

Water soluble salts: The lateritic and laterite soils contain very little of soluble salts. This is to be expected from the considerable leaching to which the soils are subjected. There is no carbonate among the soluble salts and the acid a radicals consist mainly of bicarbonate and chloride. The probable nature of the salts has not been worked out, but the cations of the salts are usually consist of sodium.

Cation Exchange properties: Since the clay complex of the lateritic and laterite soils consists mainly of hydrous oxides (iron and aluminium oxides and hydroxides) with very little of silicate minerals, they posess very low exchange capacity. The mineral complex of laterite soils generally show a base exchange capacity of 2 - 4 milliequivalents per 100 grams of soil while the values for lateritic soils range from 4 to 7 milliequivalents per 100 grams. Where the field soils show higher values as in the laterite soil, it is due to the presence of organic colloids which have 5 to 6 times the base exchange capacity of the best clay. In the lateritic soil 50% and more of the exchangeable cations consist of calcium with magnesium next in the

order of importance. The monovalent metallic cations (potassium and sodium) are present in small amounts and the degree of alkalinisation $\left[\frac{\text{(Monovalent metallic cations)}}{\text{Base exchange capacity}} \times 100\right]$ ranges from 6 to 12·4%. There is only a trace of hydrogen in the exchange complex of the Pattukkottai lateritic soil and the pH value of the surface soil is 6·80 with 7·05 for the sub-soil. However, same lateritic soils have been found to contain more hydrogen and have lower pH values.

In the laterite soil of Mangalore, calcium forms less than 25% of the total exchangeable cations. The other metallic cations together constitute another 25% or less and the rest is made of hydrogen. The soil is therefore distinctly acid having a pH of 4·8 to 4·9. Laterite soils contain no free calcium carbonate and exchangeable calcium in the colloidal complex is low with the result that the soils are always on the acid side. The soils are notoriously deficient in all bases with the result that the crops and pasture grown on them lead to mineral deficiency in man and animals. The only means of increasing the base exchange capacity and the power of the soils to retain manures and water is to incorporate heavy doses of organic manures into them, since the organic colloids have high base exchange capacity and water holding capacity. The application of lime will decrease the acidity and help in the beneficial bacterial decomposition of organic matter.

Fertility Status: The lateritic and laterite soils have low fertility status. They are generally poor in nitrogen, available phosphoric acid and lime. Total potash and total phosphoric acid may be present in adequate quantities. But the soils are notoriously poor in available phosphoric acid and any soluble phosphatic manures added to them would be immediately reverted and converted into unavailable iron and aluminium phosphates by the hydrous oxide clays. Phosphate manuring is a problem in these soils and the salvation appears to be in the application of silico-phosphates or fused phosphates which are not so readily converted into insoluble iron and aluminium phosphates. Available potash is generally deficient or on the marginal level in the lateritic and laterite soils and response to potassic manures is obtained in them. The deficiency of lime can be corrected by the application of calcium carbonate or slaked lime, and as the base exchange capacity of the soils is low the applications of one to two thousand pounds would have a marked effect on the pH of the soil.

The minimum requirement of nutrients for good crop production under the soil-climatic conditions of Madras are nitrogen (N) 0·05%, available phosphoric acid (P_2O) 0·01% available potash, (K_2O) 0·005% and lime (CaO) 0·5%. Judged by these standards it will be found that the lateritic soil of Pattukkottai and the laterite soil of Mangalore are below the minimum limit in all the essential nutrients.

BIBLIOGRAPHY

1. Menon P. K. R. and Maria Kulandai, A., Soils of Madras State Part I Madras Agri. Journal 1957, 44, Pp. 121—130.
2. Menon P. K. R. and Maria Kulandai, A., Soils of Madras State Part II Madras Agri. Journal 1957, 44, Pp. 175—184.
3. Annual Reports of the Government Agricultural Chemist, Coimbatore 1940—1955.
4. Robinson, G. W., Soils, Their Constitution, classification and properties.
5. Bonnet Jnan, A. Soils Science. 48, 25—40, 1939.
6. Pendelton R. L. & S. Scharaswana Soil Sci. 62 423—40. 1946.
7. Humbert, R. P. Soil Sci. 65. 281—290. 1948.
8. Kellogg, C. E. Commonwealth Bur. of Soil Sci. Tech Communication No. 46 76—85. 1949.

OBITUARY.

We regret to announce the sudden and unexpected demise of Sri P. KUNHIRAMAN MENON, Lecturer in Agricultural Chemistry, on 10th August 1957 at the age of 49. He was ill only for a day and he had taken a lecture class even two days prior to his demise, though he was feeling indisposed reflecting his high sense of duty and love towards his students which they could repay only by attending his funeral in large numbers.

Sri P. K. Menon entered service as an Assistant in Agricultural Chemistry in 1931 and during all these years his contributions to the Science of Soil Chemistry has been many and varied. His contributions to methods of soil, analysis, base exchange and Madras soils are well-known. Readers would recall his series of papers in the earlier issues of our Journal and elsewhere in this issue we publish the third in the series on 'Madras Red Soils' which was received for publication. We regret we could not complete the series owing to his unexpected demise.

Sri P K. Menon was a good sportsman and an excellent hockey player and was for sometime a hockey coach to the students. On his demise the Agricultural College and Research Institute loses one of its outstanding workers. We convey to his bereaved family our heartfelt condolences. May his soul rest in peace.

Quicker Methods in the Analysis of Variance

by

T. A. GOVINDA IYER,

Agricultural Research Institute, Coimbatore

Introduction: The two simplest designs for field experiments: Completely Randomised and Randomised Block, are in use in the various Agricultural Research Stations of the State. The statistical analysis of experimental data arising from these designs are done by the well known "Analysis of Variance" method developed by R. A. Fisher. Use of this technique is straight — forward and the whole analysis is easily done with the help of a calculating machine. The calculation of 'Sum of squares' in this technique of analysis is much quickened by the use of a calculator. Unfortunately, in the absence of a calculating machine, the tedious calculations are done using Tables of Squares. The object of this paper is to place before the Research workers an alternative method which involves no calculation of "Sums of Squares" and consequently is quicker and less laborious.

Materials: Field data from four experiments, two in each of completely Randomised design and of Randomised Block design conducted by the State Research Officers, have been referred to the author for statistical analysis. These data have been used to illustrate the procedures involved in the usual and the alternative methods of statistical analysis.

The alternative method requires the use of certain tables which have been published in the "Biometrika Tables for Statisticians 1954". These relevant portions of the Table are given in Appendix I Tables 1–A, 1–B and 2.

Methods and Results: (A) Completely Randomised design.

Illustration I: Indirect manuring of paddy — experiment conducted by the Government Agricultural Chemist in 1957.

(Grain yield in lb. per plot)

Replication / Treatment	1	2	3	4	5	Total	Mean
1. Control	159	131	149	161	144	744	149
2. Sesbania alone	213	199	219	223	209	1063	213
3. Sesbania + P_2O_5	214	222	233	230	212	1111	222
4. Sunhemp alone	203	209	225	200	190	1027	205
5. Sunhemp + P_2O_5	201	191	223	196	181	992	198
Total	990	952	1049	1010	936	4037	

(a) Analysis of variance method:

Analysis of Variance:

Due to	D. F.	S. S.	M. S.	F.
Between treatments	4	16365·04	4091·26	24.5
Within treatments	20	3334·20	166·71	
Total	24	19699·24		

The treatment differences are significant.

S. E./plot $= \sqrt{166 \cdot 71} = 12 \cdot 9$ lb.

(b) Alternative method:

Step 1: Form the following table from the field data obtained.

Treatment	Range	
Control	30	
Sesbania alone	24	
Sesbania + P_2O_5	21	Total = 152
Sunhemp alone	35	Mean Range = 30·4
Sunhemp + P_2O_5	42	

The range for each treatment is the difference between the maximum and the minimum yields obtained for the treatment:

Step 2: Enter Table 1–A with n = 5 and k = 5 and obtain

V = 18·4

C = 2·36

dn = 2·33

n = the size of the sample from which each range is calculated.

k = the number of samples.

Step 3: Calculate 'q' difined as

$$q = \frac{(\text{Maximum Treatment mean} - \text{Minimum Treatment mean}) \, c \times \sqrt{n}}{\text{Mean range}}$$

i. e.

$$q = \frac{73 \times 2 \cdot 36 \times 2 \cdot 24}{30 \cdot 4} = 12 \cdot 69$$

Step 4: Enter Table II with n = 5 and v = 18·4 and obtain the limits for q 5% as 4·28 and 4·25.

Thus the calculated 'q' is greater than the Table value. The treatment differences are therefore significant — the same conclusion as obtained by the Analysis of variance method.

Step 5 : The standard error per plot is given by

$$\frac{\text{Mean range}}{\text{dn}} \quad \text{i. e.} \quad \frac{30{\cdot}4}{2{\cdot}33} = 13{\cdot}04$$

A difference of 0·14 lb. per plot exist in the S. Es/plot calculated by the two methods.

Illustration 2 : Duration studies in Pot culture with groundnut by the Groundnut Physiologist.

(Wet weight in gms. of 10 plants)

Replication / Treatment	1	2	3	4	5	6	Total	Mean
D 7	26·4	23·8	28·5	21·4	23·0	24·4	147·5	24·6
L 7	28·0	24·4	24·2	22·8	25·2	25·8	150·4	25·1
L. Naph	23·0	25·5	20·2	21·6	23·7	25·6	139·6	23·3
B. Indole	25·1	26·1	24·3	23·6	24·6	21·5	145·2	24·2
Water	19·7	26·9	25·7	20·0	20·0	21·0	133·3	22·2
Control	23·8	22·9	24·5	23·6	18·6	20·4	133·8	22·3
	146·0	149·6	147·4	133·0	135·1	138·7	849·8	

(a) Analysis of variance method :

Analysis of variance :

Due to	D. F.	S. S.	M. S.	F.
Between Treatments	5	43.16	8·63	1·61
Within treatments	30	160·68	5·35	
Total	35	203·84		

The treatments do not produce significantly different wet weights. S. E/plot or obervation $= \sqrt{5{\cdot}35} = 2{\cdot}31$

(b) Alternative method :

Step 1 : Range Table :

Treatment	Range
D 7	7·1
L 7	5·2
L Naph	5·4
B. Indole	4·6
Water	7·2
Control	5·9
Total	35·4
Mean	5·9

Step 2 : n=6, k=6

From Table 1–A

v = 22·6

c = 2·56

dn = 2·53

Step 3 : $q = \frac{2{\cdot}9 \times 2{\cdot}56 \times 2{\cdot}45}{5{\cdot}9} = 3{\cdot}08$

Step 4 : Limits for $q_{5\%}$ from Table with n=6 and v=22·6 are 4·37 and 4·45.

The calculated value being less than the Table value, there is no reason to believe that the treatments tried differ significantly.

Step 5 : S. E Observation $= \frac{5{\cdot}9}{2{\cdot}53} = 2{\cdot}33$

Thus practically the same conclusion and the same S. E. have been obtained by the alternative method also.

B. *Randomised Block Design :*

Illustration 3 : Brinjal type collection summer 1955 — experiment conducted by the Horticulturist, Coimbatore.

(Yield in ozs./plot)

Blocks / Variety	I	II	III	IV	Total	Mean
H 68	152	108	133	146	539	134·75
H 93	241	256	212	219	928	232·00
H 98	60	81	49	69	259	64·75
H 89	96	122	101	85	404	101·00
H 81	102	86	98	85	371	92·75
H 61	151	176	170	167	664	166·00
Total	802	829	763	771	3165	131·88

(a) Analysis of variance method :

Analysis of variance :

Due to	D. F.	S. S.	M. S.	F.
Blocks	3	458·2		
Varieties	5	72750·4	14550·1	58·27
Error	15	3746·1	249·7	
Total	23	76954·7		

S. E./plot $= \sqrt{249{\cdot}7} = 15{\cdot}80$ ozs.

The varieties are significantly different in their yield capacities.

(b) Alternative method:

Step 1: Form the following tabe from the data presented.

Deviations from the varietal mean:

Blocks / Varieties	I	II	III	IV
68	17·25	—26·75	— 1·75	11·25
93	9·00	24·00	—20·00	—13·00
98	— 4·75	16·25	—15·75	4·25
89	— 5·00	21·00	0·00	—16·00
81	9·25	— 6·75	5·25	— 7·75
61	—15·00	10·00	4·00	1·00
Range	32·25	50·25	25·25	27·25
Total	135·00			
Mean	33·75			

To form the above table first obtain the differences of individual yields from their respective varietal means. Then, the range for each block is obtained by finding the difference between the maximum and the minimum deviation.

Step 2: Enter Table 1–B with n=6 and k=4 and obtain.

v=13·9

c=2·23

k=no. of blocks

n=no. of plots per block

Step 3: Calculate 'q' defined as

$$q=\frac{\text{(Max. mean — Min. Mean) c x } \sqrt{k}}{\text{mean range}}$$

i. e.

$$q=\frac{167\cdot25\times2\cdot23\times2}{33\cdot75}=33\cdot15$$

Step 4: Enter Table II with n=6 and v=13·9 and obtain that q 5% point lies between 4·69 and 4·64, The calculated value is higher than this value. Hence the varieties are significantly different in their yield capacities.

Step 5: The S. E/plot is given by

$$\frac{\text{Mean range}}{C}=\frac{33\cdot75}{2\cdot23}=15\cdot13$$

A difference of 0·67 ozs. exist in the S. Es/plot calculated by the two methods.

Illustration 4: Bhendi type collection — summer 1955 — experiment conducted by the Horticulturist, Coimbatore.

(Yield in ozs./plot)

Blocks / Varieties	I	II	III	IV	Total	Mean
H 10	45·75	62·00	49·50	54·00	211·25	52·81
H 31	64·00	62·25	38·50	43·00	207·75	51·94
H 12	47·00	40·50	30·25	32·75	150·50	37·62
H 13	46·25	56·25	62·75	34·75	200·00	50·00
H 15	59·50	52·75	66·00	47·75	226·00	56·50
H 14	52·50	72·50	25·50	48·00	198·50	49·62
Total	315·00	346·25	272·50	260·25	1194·00	

(a) Analysis of variance method

Analysis of variance:

Due to	D. F.	S. S.	M. S.	F.
Blocks	3	781·89		
Varieties	5	827·28	165·46	1·37
Error	15	1805·71	120·38	
Total	23	3414·88		

S. E/plot = $\sqrt{120\cdot38}$ = 10·97

There is no significant difference in the yields of the varieties.

(b) Alternative method:

Step 1:

Table of deviations from the varietal means:

Blocks / Variety	I	II	III	IV
H 10	— 7·06	9·19	— 3·31	1·19
H 31	12·06	10·31	—13·44	— 8·95
H 12	9·38	2·88	— 7·37	— 4·87
H 13	— 3·75	6·25	12·25	—15·25
H 15	3·00	— 3·75	9·50	— 8·75
H 14	2·88	22·88	—24·12	— 1·62
Range	19·22	26·23	36·37	16·44
Total	98·56			
Mean	24·64			

Step 2 :

k = 4 (no. of blocks)
n = 6 (no. of plot/block)

From 1-B with k = 4 and n = 6, obtain

v = 13·9
c = 2·23

Step 3 :

$$q = \frac{(\text{Max. Mean} - \text{Min. mean})\ c \times \sqrt{k}}{\text{Mean range}} =$$

$$= \frac{18.88 \times 2{\cdot}23 \times 2}{24{\cdot}64} = 3{\cdot}42$$

Step 4 : q 5% point for n = 6 and v = 13·9 from Table II lies between 4·69 and 4·64. The calculated 'q' being less than this value, the varietal differences in yield are not significant.

Step 5 :

$$\text{S. E/plot} = \frac{\text{Mean range}}{C} = \frac{24{\cdot}64}{2{\cdot}23} = 11{\cdot}04$$

The S. Es. obtained by the two methods are practically be same.

Discussion and Conclusion : It is evident from the illustrations that the alternative methd is much less time-consuming because the ranges of values alone are calculated instead of the "Sums of squares", and the ranges are very easily calculated. The statistical conclusions arrived at are also identical.

The statistical analysis however, does not stop with the test of significance. The error involved in experiment due to unknown and uncontrolled causes marked as 'error' in the analysis of variance is further used in the comparison of treatment responses by calculating the standard errors. The S. E. per plot or per observation which is obtained by extracting the square root of the error mean square is a fundamental statistical measure. The closer the agreement on the values of the S. E. between the two methods, the greater will be the justification for the adoption of the new method.

In the illustrations 1 and 3 the values of S. E. do not agree as closely as those obtained in the illustrations 2 and 4. In the former experiments however, great variations exist in the treatment responses, while the treatment effects in experiments 2 and 4 do not differ very much. Thus, the agreement in the values of S. E. is close

when the treatment differences are small. This is an important point counting in the favour of the new method, because it is only in such marginal cases the alternative method should give S. E. values as precise as the usual method so that its adoption may not lead to loss of information.

Thus, the alternative method is a good substitute for the usual method of statistical analysis. It saves time with no loss of efficiency.

Summary : An alternative method of statistical analysis of date arising from completely Randomised and Randomised Block designs is illustrated with worked out examples. The method does not involve calculations of 'Sums of Squares' required by the usual Analysis of Variance method and hence is less time-consuming and less laborious. The method also does not seem to involve any loss of efficiency.

Acknowledgments : The author is much thankful to the Biometrika trustees for the permission kindly granted to reproduce the Tables 30 A and 30 B and the 5% points in Table 29 from Biometrika Tables for Statisticians Vol. 1 (1954).

REFERENCES

1. Pearson E. S. & Hartley H. O. (1954) Biometrika Tables for Statisticians Vol. 1 Cambridge University Press, England.

APPENDIX I

TABLE I–A

Scale factor, 'c', and equivalent degrees of freedom, 'v', appropriate to a simple classification into 'k', groups of 'n' observations.

K \ n	2		3		4		5		6		7		8		9		10	
	V	C	V	C	V	C	V	C	V	C	V	C	V	C	V	C	V	C
1.	1·0	1·41	2·0	1·91	2·9	2·24	3·8	2·48	4·7	2·67	5·5	2·83	6·3	2·96	7·0	3·08	7·7	3·18
2.	1·9	1·28	3·8	1·81	5·7	2·15	7·5	2·40	9·2	2·60	10·8	2·77	12·3	2·91	13·8	3·02	15·1	3·13
3.	2·8	1·23	5·7	1·77	8·4	2·12	11·1	2·38	13·6	2·58	16·0	2·75	18·3	2·89	20·5	3·01	22·6	3·11
4.	3·7	1·21	7·5	1·75	11·2	2·11	14·7	2·37	18·1	2·57	21·3	2·74	24·4	2·88	27·3	3·00	30·1	3·10
5.	4·6	1·19	9·3	1·74	13·9	2·10	18·4	2·36	22·6	2 56	26·6	2·73	30·4	2·87	34·0	2·99	37·5	3·10
10.	9·0	1·16	18·4	1·72	27·6	2·08	36·5	2·34	44·9	2·55	52·9	2·72	60·6	2·86	67·8	2·98	74·8	3·09
dn.		1·13		1·69		2·06		2·33		2·53		2·70		2·85		2·97		3·08
C. D.	0·88		1·82		2·74		3·62		4·47		5·27		6·03		6·76		7·45	

Table 30–A of the 'Biometrika Tables for statisticians' Vol. 1 — 1954, edited by E. S. Pearson and H. O. Hartley and ublished by Cambridge University Press, London — Reproduced with the kind permission from the Biometrika trustees.

TABLE 1–B

Scale factor, 'c' and equivalent degrees of freedom, 'v' for analysis of double classification, with 'K' blocks and 'n' treatments.

K \ n	2		3		4		5		6		7		8		9	
	V	C	V	C	V	C	V	C	V	C	V	C	V	C	V	C
2	1·0	1·00	2·0	1·35	2·9	1·58	3·8	1·75	4·7	1·89	5·5	2·00	6·3	2·10	7·0	2·18
3	1·9	1·05	3·7	1·48	5·6	1·76	7·4	1·96	9·3	2·12	11 3	2·26	13·4	2·37	15·7	2·46
4	2·7	1·07	5·4	1·54	8·2	1·84	11·0	2·06	13·9	2·23	16 9	2·38	20·1	2·50	23 6	2·60
5	3 6	1·08	7·2	1·57	10·9	1·88	14·6	2·12	18·5	2·30	22·4	2·45	26 6	2·57	31·1	2·68
6	4·5	1·09	8·9	1·59	13 6	1·91	18·2	2·15	23·0	2 34	27·9	2·49	33·0	2 62	38·3	2·73
7	5·4	1·09	10·7	1·61	16·3	1 93	21·8	2·18	27·6	2·37	33·3	2·52	39·3	2 65	45·4	2·76
8	6·3	1·10	12 5	1·62	19 0	1·95	25·4	2·20	32·1	2 39	38·7	2·55	45·6	2 68	52·5	2·79
9	7·1	1·10	14·3	1·63	21·7	1·96	29·0	2·21	36 6	2·41	44·0	2·57	51·8	2·70	59 6	2·81
10	8·1	1 10	16·1	1·63	24·4	1·97	32·6	2·22	41·0	2 42	49·3	2·58	57 9	2·71	66·6	2·83
20	16·7	1·11	33·9	1·66	51·5	2·02	68·8	2.28	86 0	2·48	103·0	2 64	119·0	2·78	134 0	2·90
dn.		1·13		1 69		2 06		2·33		2·53		2 70		2·85		2·97
C. D.	0·87		1·80		2·71		3·62		4·50		5·33		6·10		6.79	

Table 30 B of the 'Biometrika Tables for statisticians' Vol. 1 — 1954 edited by E. S. Pearson and H. O. Hartly and Published by Cambridge University Press, London — Reproduced with the kind permission from the Biometrika trustees.

TABLE II

Percentage points of the Studentized range, $q = (\bar{x}_n - \bar{x}_1)/Sv$. Upper 5% points.

v \ n	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	18·00	27·0	32·8	37·1	40·4	43·1	45·4	47·4	49·1	50·6	52·0	53·2	54·3	55·4	56·3	57·2	58·0	58·8	59·6
2	6·09	8·3	9·8	10·9	11·7	12·4	13·0	13·5	14·0	14·4	14·7	15·1	15·4	15·7	15·9	16·1	16·4	16·6	16·8
3	4·50	5·91	6·82	7·50	8·04	8·48	8·85	9·18	9·46	9·72	9·95	10·15	10·35	10·52	10·69	10·84	10·98	11·11	11·24
4	3·93	5·04	5·76	6·29	6·71	7·05	7·35	7·60	7·83	8·03	8·21	8·37	8·52	8·66	8·79	8·91	9·03	9·13	9·23
5	3·64	4·60	5·22	5·67	6·03	6·33	6·58	6·80	6·99	7·17	7·32	7·47	7·60	7·72	7·83	7·93	8·03	8·12	8·21
6	3·46	4·34	4·90	5·31	5·63	5·89	6·12	6·32	6·49	6·65	6·79	6·92	7·03	7·14	7·24	7·34	7·43	7·51	7·59
7	3·34	4·16	4·68	5·06	5·36	5·61	5·82	6·00	6·16	6·30	6·43	6·55	6·66	6·76	6·85	6·94	7·02	7·09	7·17
8	3·26	4·04	4·53	4·89	5·17	5·40	5·60	5·77	5·92	6·05	6·18	6·29	6·39	6·48	6·57	6·65	6·73	6·80	6·87
9	3·20	3·95	4·42	4·76	5·02	5·24	5·43	5·60	5·74	5·87	5·98	6·09	6·19	6·28	6·36	6·44	6·51	6·58	6·64
10	3·15	3·88	4·33	4·65	4·91	5·12	5·30	5·46	5·60	5·72	5·83	5·93	6·03	6·11	6·20	6·27	6·34	6·40	6·47
11	3·11	3·82	4·26	4·57	4·82	5·03	5·20	5·35	5·49	5·61	5·71	5·81	5·90	5·99	6·06	6·14	6·20	6·26	6·33
12	3·08	3·77	4·20	4·51	4·75	4·95	5·12	5·27	5·40	5·51	5·62	5·71	5·80	5·88	5·95	6·03	6·09	6·15	6·21
13	3·06	3·73	4·15	4·45	4·69	4·88	5·05	5·19	5·32	5·43	5·53	5·63	5·71	5·79	5·86	5·93	6·00	6·05	6·11
14	3·03	3·70	4·11	4·41	4·64	4·83	4·99	5·13	5·25	5·36	5·46	5·55	5·64	5·72	5·79	5·85	5·92	5·97	6·03
15	3·01	3·67	4·08	4·37	4·60	4·78	4·94	5·08	5·20	5·31	5·40	5·49	5·57	5·65	5·72	5·79	5·85	5·90	5·96
16	3·00	3·65	4·05	4·33	4·56	4·74	4·90	5·03	5·15	5·26	5·35	5·44	5·52	5·59	5·66	5·72	5·79	5·84	5·90
17	2·98	3·63	4·02	4·30	4·52	4·71	4·86	4·99	5·11	5·21	5·31	5·39	5·47	5·55	5·61	5·68	5·74	5·79	5·84
18	2·97	3·61	4·00	4·28	4·49	4·67	4·82	4·96	5·07	5·17	5·27	5·35	5·43	5·50	5·57	5·63	5·69	5·74	5·79
19	2·96	3·59	3·98	4·25	4·47	4·65	4·79	4·92	5·04	5·14	5·23	5·32	5·39	5·46	5·53	5·59	5·65	5·70	5·75
20	2·95	3·58	3·96	4·23	4·45	4·62	4·77	4·90	5·01	5·11	5·20	5·28	5·36	5·43	5·49	5·55	5·61	5·66	5·71
24	2·92	3·53	3·90	4·17	4·37	4·54	4·68	4·81	4·92	5·01	5·10	5·18	5·25	5·32	5·38	5·44	5·50	5·54	5·59
30	2·89	3·49	3·84	4·10	4·30	4·46	4·60	4·72	4·83	4·92	5·00	5·08	5·15	5·21	5·27	5·33	5·38	5·43	5·48
40	2·86	3·44	3·79	4·04	4·23	4·39	4·52	4·63	4·74	4·82	4·91	4·98	5·05	5·11	5·16	5·22	5·27	5·31	5·36
60	2·83	3·40	3·74	3·98	4·16	4·31	4·44	4·55	4·65	4·73	4·81	4·88	4·94	5·00	5·06	5·11	5·16	5·20	5·24
120	2·80	3·36	3·69	3·92	4·10	4·24	4·36	4·48	4·56	4·64	4·72	4·78	4·84	4·90	4·95	5·00	5·05	5·09	5·13
	2·77	3·31	3·63	3·86	4·03	4·17	4·29	4·39	4·47	4·55	4·62	4·68	4·74	4·80	4·85	4·89	4·93	4·97	5·01

'n' is the size of sample from which the range is obtained and 'v' is number of degrees of freedom of 'Sv.'

Table 29 of the 'Biometrika Tables for Statisticians', Vol. 1—1954—Reproduced with the kind permission from the Biometrika trustees.

Manuring Crops

by

Dr. A. MARIAKULANDAI

Agricultural Research Institute, Coimbatore

(Contd. from July 1957 issue)

[Abstract of the Curzon Lectures]

Sugarcane: Manurial experiments have been conducted during the past four decades on sugarcane in Madras State primarily in the Research Stations at Gudiyattam in North Arcot District and Palur in South Arcot District.

Palur: Comparison of the effect of organic and inorganic nitrogen, alone and in combination was made at the following levels, namely,

(1) Ammonium sulphate at 75 lb. N and 150 lb. N.,

(2) Groundnut cake at 75 lb. N and 150 lb. N.,

(3) 75 lb. N – half as groundnut cake and half as ammonium sulphate.,

(4) 150 lb. N. half as groundnut cake and half as ammonium sulphate.

It was found that 150 lb. N when applied half as groundnut cake and half as ammonium sulphate was the best. A combined manurial and varietal trial at the same station revealed that,

(a) Co. 419 with 75 N gave as good yields as Co. 349 with 150 N.

(b) Co. 419 is capable of thriving even with less doses of N.

(c) Higher dosages of N have not affected the sucrose content.

(d) P_2O_5 and K_2O either alone or in combination did not influence the yield or quality of cane. Other experiments have shown that a mixture of groundnut cake and ammonium sulphate in the ratio of 3 : 1 is the best.

Optimum nitrogen dose trial: The experiment was conducted with graded levels of groundnut cake with and without cattle manure and the effect on quality of jaggery and yield was noted. The results indicated no significant differences in yields, between cattle manure and no cattle manure series, but there was regular increase in the tonnage of cane with increase in N level up to the maximum

dose of 250 lb. N per acre. In respect of both the varieties tried, there was no difference in the quality of juice by the application of cattle manure. The highest sucrose content and purity were obtained in the plots manured with 100 lb. N. The higher doses of N reduced slightly the sucrose content in the juice and its coefficient of purity. When the economics of the manurial treatments were considered, it was observed that with the increase in the dose of N upto 250 lb., there was increased net income. As a substantial increase in the yield of cane occurred even at the highest dose of nitrogen, viz. 250 lb. per acre, the point at which further addition of N does not result in increased yields could not be determined in this trial.

To assess the optimum dose of N at the Agricultural Research Station, Gudiyatham, six levels of nitrogen per acre as groundnut cake over a basal dressing of 10 tons of cattle manure were tried with Co. 419 variety. There was good response to nitrogenous manuring upto 200 lb. nitrogen per acre. The yields of plots which did not receive oil cake were very poor, though the plots had received cattle manure as basal dressing. Sugarcane therefore requires adequate concentrated nitrogenous manure like oil cakes upto 200 lb. of nitrogen per acre to give optimum yields according to this trial.

In a set of trials with a mixture of ammonium sulphate and groundnut cake and chilean nitrate to ascertain the influence of the form of N, chilean nitrate fared better both from the point of cane yield and sucrose content per acre. No difference was, however, noticeable either in cane yield or quality when N was supplied in different forms like ammonium sulphate, groundnut cake,, castor cake, mixture of groundnut cake and ammonium sulphate, and a mixture of castor cake, and ammonium sulphate. The application of basal dressings like farm yard manure, farm yard manure plus sunnhemp (intersown) or superphosphate did not make any difference. Earlier trials showed that a mixture of groundnut cake and ammonium sulphate (in the proportions of 2 : 1 N) was suitable for this tract.

Effect of phosphatic manures : Applications of superphosphate at one cwt. per acre did not have any beneficial effect on the quality of juice or on the yield.

Effect of manuring at the time of planting on germination of Sugarcane : To study the effect of concentrated manures on the germination of sugarcane when applied at the time of planting,

50 lb. N as castor cake or as sulphate of ammonia or as a mixture of both in the proportion of 2/3 castor cake to 1/3 as ammonium sulphate was applied to the variety Co. 419. The results of three years trials indicated that the application of concentrated manures at the time of planting had no adverse effect on the germination of the cane.

Cotton : Manurial experiments on cotton have been done in the erstwhile Madras State in tha Agricultural Research Stations at Koilpatti (Black soil), Coimbatore (Mixed Black and Red Soil — irrigated), Hagari (Black cotton soil), Bellary (Black cotton soil) and Guntur (Black cotton soil). In general, cotton is rotated with some cereal, cumbu or sorghum being most common. The Experiments upto 1930 gave the following results.

Kovilpatti : (Black soil) — Groundnut cake at 500 lb. per acre plus super phosphate at 112 lb. or ammonium sulphate 224 lb. plus super phosphate at 112 lb. gave 38% increase over "no manure" with no difference between themselves. Residual effects on cumbu and cholam were also significant. The same manures applied to the cereal and residually to cotton also produced significant results in a 12% increase. Prickly pear compost had no effect.

Coimbatore : (Cotton Breeding Station) (Black soil) — Basal cattle manure or compost with a top dressing of ammonium sulphate at 30 lb. N per acre alone or in combinatiom with super phosphate at 40 lb. P_2O_5 and potasium sulphate at 25 lb. K_2O per acre gave higher yields than "no manure". Green manure (sunnhemp) gave 19% increase over "no manure" and also cattle manure at 12 cartloads per acre. Ammonium suphate at 448 lb. plus super phosphate at 224 lb. per acre applied to sorghum had no residual effect on succeeding cotton crop. In general therefore, without a basal dressing of cattle manure, cotton was not benefitted directly or residually by artificials.

Hagari : (Black cotton soil) — Ammonium sulphate or cyanamide at 224 lb. per acre and super phosphate 112 lb. per acre applied to sorghum had residual effect on cotton. Ammonium sulphate at 20 lb. N per acre or sodium nitrate at 20 pounds N per acre applied to cotton depressed the yield.

Bellary : (Black cotton soil) — Safflower cake at 100 lb. per acre alone or combined with super phosphate at 300 lb. per acre or sodium nitrate at 300 lb. per acre or combined with basic slag at

300 lb. per acre depressed the yields. Cake at 1000 lb. per acre, sodium nitrate at 300 lb. per acre or super phosphate at 300 lb. per acre had no residnal effect on cotton.

Guntur (Black cotton soil) : Ammonium sulphate at 224 lb. per acre plus superphosphate at 112 lb. per acre applied to sorghum had no residual effect on cotton. Cattle manure plus ammonium sulphate was not better than cattle manure alone.

Subsequent experiments between 1930 and 1940 revealed the following :

Irrigated Cotton : In Coimbatore, continued application of bulky organic manures, viz. cattle manure and green manure increased the yield during a three year experiment. Cattle manure gave an increase of 22% over control while green manure ploughed in situ yielded 16% over control. In another experiment to test the relative effects of artificials, viz. Ammonium sulphate (60 lb. N) alone, and in combination with potassium sulphate (40 lb. K_2O) and super phosphate (80 lb. P_2O_5), favourable results in two out of the three years have been obtained, with N + P and N + K + P, the increase being 40 and 34% respectively over an average yield of 560 lb. kapas. In the presence of cattle manure applied regularly over a number of years, the response for the various combinations of artificials is not significant. Cotton was grown in a year in the New Permanent Manurials at Coimbatore. Cattle manure alone at 5 tons gave 31% over control while N + K + P (at one cwt. each of ammonium sulphate, potassium sulphate and 3 cwt. of super phosphate) gave only 10% over the control yield of 1200 lb. Basal dressing with cattle manure gave an uniform 15% increase in all the treatments in the New Permanent Manurial plots.

Dry Cotton : Manuring of cotton grown under dry conditions has not been practised much because of its doubtful value. In the Old Permanent Manurial plots at Coimbatore, plots treated with cattle manure, direct and residual, N + K + P and N + P gave 136, 164, 75 and 201% respectively over the control (no manure) yield of 161 lb. Kapas per acre. In Guntur, Nandyal and Hagari no consistent or reliable result in favour of artificials could be obtained in 3 years of experiment by manuring with ammonium sulphate (2 cwt.) plus superphosphate (1 cwt.) with and without a basal dressing of 5 cartloads of cattle manure. In favourable years of rainfall however, 19 and 25% increases have been recorded in Guntur for

fertilisers applied in combination with cattle manure. 16% over control yield of 258 lb. was similarly obtained in Nandyal when artificials were applied in combination with cattle manure. In the year of application of cattle manure its effect is not at all felt except in combination with artificials. But residual effects of the manures applied to the previous cereals have been reported.

In Nandyal, cattle manure (5 cartloads per acre) and artificials (Ammonium sulphate 2 cwt. and super phosphate 1 cwt.) applied individually and in combination to sorghum gave residual effect on the succeding cotton crop and gave an increased yield of 12, 26 and 38% respectively over control yield of 223 lb. kapas per acre. In another set of experiments, cotton manured similarly was followed by sorghum and succeeding cotton crop and the corresponding increases were 11, 7 and 20% respectively over no manure plots. Similarly at Hagari, artificials applied to cholam crop showed residual effects on the succeeding cotton crop, in two out of the three years with 38% increase over control (202 lb. kapas). The residual value of composts and farm yard manure applied at 50 lb. levels of N to previous crop of Tenai has increased the yields of the succeeding cotton by 2 and 11% respectively. When sorghum was the previous manured crop, the corresponding increases were 36 and 32% with no significant difference between the two manures.

In Kovilpatti, intensive studies have been carried out on the response of cotton to manures of different types. Ammonium sulphate at 2 cwt. per acre in split doses of one, two and three instalments at varying levels did not produce any significant difference. All of them increased the yield, the increases being of the order of 20 to 25% over no manure (560 lb. kapas.) Cotton kapas yield was increased by 30% by applying 1 cwt. super phosphate plus ammonium sulphate at 2 cwt. or groundnut cake at 250 lb. with 1 cwt. ammonium sulphate over a basal dressing of 6 cart loads of cattle manure while only 17% increase was recorded with only 1 cwt. of ammonium sulphate *or* 500 lb. of groundnut cake *or* 125 lb. groundnut cake with 56 lb. ammonium sulphate. The direct application of molasses at about 5 tons per acre in one year has given an increase of 46% over control.

Increase over control of 15 to 30% (700 lb. kapas) has been observed in experiments conducted to test the residual effects of ammonium sulphate at 2 cwt. per acre or groundnut cake at 500 lb. per acre applied to the previous cereal crop

of cumbu or sorghum over a basal dressing of 4 cartloads of cattle manure, 2 cartloads of cotton compost plus 1 cwt. of super. In the case of residual effect of the manures on cotton in second year, after cotton and cumbu or cotton and sorghum, 9 to 10% increases over control have been reported. Based on the experimental results in the various farms in the state, the general recommendations are (i) 20 lb. N. as ammonium sulphate for rainfed karunganni which may be increased to 40 lb. in Tirunelveli tract (ii) 40 lb. N. as ammonium sulphate for irrigated cambodia which may be increased to 60 lb. in Coimbatore tract. This may be supplied in two doses, namely prior to sowing and at flowering time.

Response of cotton for major nutrients: Some experiments have been done under the Free Fertiliser Domonstration Scheme by the I. C. A. R. in 1954—55 in Pepsu, Punjab and Rajasthan and the responses obtained in their experiments along with the average responses obtained in the Madras State Manurial Experiments are presented in Appendix (of next issue). For dry cotton, State experiments have given 3 to 6 lb. cotton kapas per lb. of N in the inorganic form and 3 to 18 lb. kapas per lb. of N in the organic form. The trials done outside the State have given 0·6 to 1·2 lb. kapas per lb. of inorganic nitrogen and 1·4 lb. kapas per lb. of organic nitrogen.

In the case of irrigated cotton, State Permanent Manurial experiments gave 2 to 3·5 lb. of kapas per lb. of N in the inorganic form and 9 to 39 lb. when organic form of N was supplied.

The Free Fertiliser Demonstration trials done outside the State revealed a response of 2·2 lb, of kapas per lb. of nitrogen.

The response to phosphorus or potash had been low and uneconomical in all trials.

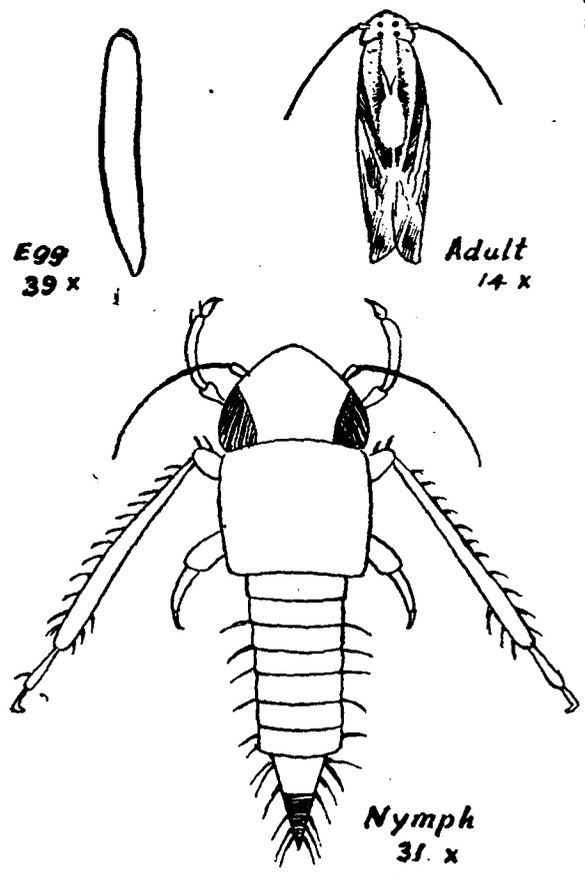
[to be continued]

Research Notes

Some observations on the incidence and habits of *Pruthiana sexnotata*, Izzard.

A new jassid pest was noted as occuring on sugarcane crop throughout South Kanara for the first time during 1954. The insect was sent to the British Museum, London, for identification and was subsequently named and described as a new genus and new species, *Pruthiana sexnotata* by Izzard (1955). The writer had occasion to conduct studies on the incidence, habits and life history of the jassid, and the preliminary observations made are presented in this short note.

Habits: In South Kanara the sugarcane crop is planted during the period December to February and the main variety is Co. 419. The jassids make their first appearence in the month of July when only stray specimens of adults and early instar nymphs can be noted. They are noted from September to November, throughout the sugarcane growing area of South Kanara and decline by December. Thus the pest starts appearing in the fields only after the crops have received fairly heavy rainfall for more than a month.



Pruthiana sexnotata. Izzard. Life history stages.

The sugarcane plants were affected by hundreds of jassids feeding on the foliage. The jassids, both adults and nymphs were always observed to remain on the under surface of the lowermost leaves of the plant, thus feeding mainly on the older leaves of the plant. The adults are very active hopping or flying off to other leaves at the least disturbance. The nymphs are less active and can be seen crawling

about on the under surface of the foliage. They are also able to jump short distances when disturbed. The nymphs showed a gregarious tendency which was more pronounced in the case of earlier instars.

Life history: Adults and nymphs of jassids were collected periodically from South Kanara and bred in large numbers at Coimbatore in field cages during the months of September, October and November. They appeared to thrive well when the cages were regularly sprayed with water from the outside, to increase the humidity inside the cages.

Adults in batches were separated into suitable laboratory cages containing live sugarcane plants for feeding and egg laying. A number of attempts were unsuccessful as the jassids died without oviposition. But a batch of adults released into the cage during October 1955 laid number of eggs on the foliage. The eggs are inserted in rows into grooves on the upper surface of the leaf. The egg as shown in the figure, is cigar shaped with one end pointed and the other blunt. The eggs hatched out within 5 to 7 days and small whitish nymphs emerged. In all 22 nymphs emerged out of which only five grew up to the adult stage, while the rest died during the nymphal stage itself. The nymphal period was about 16 days under laboratory conditions. The longevity of adults in captivity varied from 4 to 14 days. The different stages of the insect are shown in the figure.

Control trials: Experiments for controlling the pest were conducted at Mangalore in Sugarcane fields where the jassid infestation was high during the period of maximum incidence using the following insecticides.

1.	D. D. T. 50% wettable powder	1 lb. in 25 gallons of water.
2.	B. H. C. 50% wettable powder	1 lb. in 25 gallons of water.
3.	Endrin emulsifiable concentrate	1 oz. in 12½ gallons of water.
4.	Folidol	1 oz. in 12½ gallons of water.

Of the above four treatments, D. D. T, Endrin and Folidol spray were found to be very effective in controlling the pest while B. H. C. spray was not so effective.

Acknowledgement: I am grateful to Janab Mohammed Basheer, Government Entomologist, and Sri A. R. Seshadri, Assistant Entomologist for making valuable suggestions.

BIBLIOGRAPHY.

1. Ananthanarayanan K. P. (1954) A note on a new jassid pest on sugarcane from the Madras State. Indian Jour., Ent., 16, Part IV.

2. Izzard, R. J. (1955) A new genus and species of Nirvaniinae (Homoptera, Cicadellidae) from South India. Indian Jour. Ent., 17, Part II.

Agricultural College and Research Institute, Lawley Road P. O., Coimbatore.

K. C. CHANDY.

Medicinal Ash-Gourd — (A New Variety).

A new variety of ash-gourd which has hitherto been unrecorded is found cultivated in the Ernad and Walluvanad Taluks of Malabar. It is said that the shreddings of the hard pulp of this variety is used for the preparation of an ayurvedic medicine called "Kushmanda Lehyam" and so this variety is locally known as "Vaidhya Kumbhalom" meaning thereby, medicinal ash-gourd. This variety is different from the common variety in that the fruits are small, more or less round and slightly bigger in size than a cricket ball. The rind of the fruit of this variety is thicker, with a thicker coating of white waxy bloom, the leaves are smaller, the vines thinner and the seeds smaller than those of the common variety. It is also found to be more prolific in bearing than the common ash-gourd. The pulp of the fruit of this medicinal variety is harder in consistency than that of the common ash-gourd. It has also remarkable keeping qualities and it is reported that Ayurvedic physicians keep them for years. The fruit of this new variety can be used for culinary purposes, just like the ordinary variety and its size is such that it becomes handy for an average family for a day's use, while the fruit of the ordinary variety is often too big and has therefore to be used in portions only. While the common ash-gourd is generally cultivated in the summer months, the new variety can be grown in all seasons and can be trailed on the ground or to shrubs and trees. Further, it is observed that the new variety requires less moisture and is more resistant to pests and diseases.

Morphology: Plant annual; stem ribbed, fistular, hispid; tendrils lateral, trifid; leaves simple, five angled, toothed, soft, downy, three to four inches long and about the same in breadth; petioles round, hairy; male flowers axillary, solitary, peduncled, yellow, large; calyx segments obtusely pinnatifid; female flowers like the male, axillary, solitary and peduncled; calyx as in the male; fruit roundish, four to five inches in diameter without any undulations on the surface; young fruits hairy, hair falling off as the fruit matures leaving a thick coating of white waxy bloom; seeds white, flat, margins swollen and tips pointed.

Culture: This variety is cultivated both in the monsoon and summer seasons in Malabar. As a monsoon crop, it is grown in house compounds and the vines are trailed on the shrubs or trees and on the roofs of buildings. The sowing is done in the month of May. During summer it is grown in single crop paddy lands after the harvest of paddy in the month of November. Pits of 2 x 2 x 2 feet size are dug at distances of 6 feet in the row and 8 feet between the rows, and then filled up with dry leaves and burnt. After the pits have cooled the ash in the pit is well mixed up with the soil. Afterwards, well decomposed cattle manure is applied to each pit at the rate of about 25 lbs. and mixed well with the top soil. Seeds five or six, are then dibbled at distances of 5 to 6 inches in the pit, which germinate 5 to 6 days after sowing. The pits are pot-watered daily till the seeds germinate and thereafter watering is done once in three days. Three weeks after germination one hoeing is given round about the plants. After two or three days of hoeing a mixture of powdered cattle manure or goat manure and ash is applied to each plant at the rate of two handfuls. Irrigation channels are formed and the plants are irrigated profusely, immediately after manuring. Afterwards irrigations are given once in a week. For the monsoon crop irrigation is not necessary as there will be copious rainfall during that period.

The vines are trailed on the ground and the flowering commences about sixty days after sowing and it takes 2 to 2½ months for the fruits to mature completely. Fruits are harvested when the fruit stalk shows symptoms of drying up. For use as a vegetable the fruits can be harvested when 1½ to 2 months old. On an average each vine bears 8 to 10 fruits and the fruits weigh 1 to 1½ lb. each. An yield of 15000 and 18000 lb. of fruits is obtained from an acre.

Hybridization: To test whether this new variety belongs to a species different from that of the ordinary ash-gourd namely, *Benincasa cerifera* Savi and whether it could be used in breeding, it was crossed with the common variety of ash-gourd using the new variety as the female parent. The seed-setting was good and on sowing, the seeds showed true hybridity. The first generation was intermediate in character in all morphological characters and were more prolific than both the parents. The second generation was raised allowing natural cross pollination and a wide range of sizes were obtained. All the fruits were, however, smaller than that of the common variety *Benincasa cerifera* Savi. The size, weight and the yield of fruits of both the parents and the hybird are furnished below.

	Length cm.	Breadth cm.	Length by Breadth.	Weight of each fruit. (lb.)	Number of fruits obtained per vine.
Common ash-gourd ..	63·6	58·2	1·09	5	3
Medicinal ash-gourd ..	23·2	23·8	0·97	1·5	9
Hybrid ..	47·4	41·1	1·15	2	12

Thus the new variety may probably be a smaller variety of *Benincasa cerifera* Savi (common ash-gourd) and it is not a wild type as it is not dominant in size character. It is useful in hybridization work as it shows good hybrid vigour, resistance to pests and diseases and seasonal adaptabilities.

Acknowledgement: My thanks are due to Sri A. Abdul Samad, Paddy Specialist, Coimbatore for his guidance and encouragements in conducting this study and to Sri T. R. Narayanan, Plant Physiologist, Coimbatore for his valuable suggestions in the preparation of this paper.

REFERENCES.

1. W. Roxburgh (1832) Flora Indica Volume III.
2. Macmillan H. B. (1925) Tropical Gardening and Planting.

Agricultural Research Station, Pattambi.

R. GOPALAKRISHNAN.

Weather Review — For July, 1957

RAINFALL DATA (IN INCHES)

Division	Station	Total rainfall for the month	Departure from normal	Total since 1st January 1957
North	Madras (Meenambakkam)	4·3	+ 0·7	7·1
	Tirurkuppam*	4·9	+ 0·2	8·9
	Vellore	4·3	— 0·3	12·2
	Gudiyatham*	0·3	— 4·6	17·1
East Coast	Palur*	4·4	+ 0·2	7·8
	Tindivanam*	7 8	+ 4·4	11·8
	Cuddalore	7·1	+ 4·5	10·1
	Nagapattinam	2·8	+ 1·1	6·3
	Aduthurai*	4·7	+ 2·4	7·7
	Pattukottai*	2·4	— 1·4	7·4
Central	Salem	2·7	— 1·1	9·0
	Coimbatore (A. M. O.)* ..	1·4	— 0·6	8.0
	Coimbatore	0·9	— 0·8	6·6
	Tiruchirapalli	1·2	+ 0.1	5·7
South	Madurai	0·8	— 1·2	4·7
	Pamban	0·8	+ 0·3	3·2
	Koilpatti*	3.2	+ 2·5	6·9
	Palayamcottai	Nil	— 0·3	8·7
	Ambasamudram*	0·2	— 0·3	6·0
	Nagarcoil	1·5	— 1·4	29·2
Hills	Kodaikanal	6·5	+ 1·8	21·8
	Coonoor*	2·6	— 0·3	35·3
	Ootacamund*	3·9	— 2·4	40·0
	Nanjanad*	7·7	— 0·8	35·9

Note:— 1. *Meteorological Stations of the Madras Agricultural Department.

The wet-spell that commenced to prevail on 27—6—'87 after a temporary weakening of the South West monsoon, continued upto and inclusive of 2—7—57. On 3—7—57 and the succeeding day, the weather was dry throughout the Madras State. Due to the strengthening of the monsoon in the West coast, interior Madras received localised thundershowers on 5—7—57. Except for isolated showers in Madras State on 6—7—57, the weather was mainly dry elsewhere. Rains or thundershowers occured at a few places in the Madras State on 7—7—57 and the succeeding day. Monsoon revived its vigour over north Kerala and Coastal Mysore on 8—7—57. The weather was dry throughout the Madras State on 9—7—57. For eight days from 10—7—57, the monsoon was vigorous in Kerala and Coastal Mysore, and scattered rains or thundershowers were received in Madras State during this period. Due to the temporary weakening of the monsoon over Kerala, Madras State experienced dry weather for five days from 18—7—57. Though the monsoon continued to be weak over Kerala, localised rains were received in Madras State on 23—7—57. Rains or thundershowers were widespread in north coastal Madras and scattered in the remaining regions on 24—7—57. Showers were localised in Tamilnad on 25—7—57, and scattered on 26—7—57. On 27—7—57, conditions were becoming favourable for a general break in monsoon

rains over the country, while Madras State received localised showers on that day. On 28—7—57, the axis of monsoon trough continued to be close to the foot of Himalayas and the monsoon was generally weak over the country. The weather was dry in Madras State on that day. As the monsoon has strengthened in south east Bay of Bengal and Andaman Sea on 29—7—57, showers were localised in Madras State on 29—7—57, and scattered in interior Madras on 30—7—57. Showers were received at a few places in Madras State on 31—7—57.

The day temperatures were generally below normal thoughout the Madras State, with a little fluctation during the prevalence of dry-spell for five days from 18—7—57.

Rainfall: The note-worthy rainfall and the Zonal rainfall for the month are furnished below:

Noteworthy Rainfalls for the month

S. No.	Date	Name of place	Rainfall in inches
1.	24—7—57	Guddaloro	3·90
2.	do	Kovilpatti	2·03
3.	do	Vellore	3·86
4.	25—7—57	Kodaikanal	3·66

Zonal Rainfall for the month in inches

Name of Zone	Rainfall for the month	Departure from Normal	Remarks
North	3·5	— 1·0	Below normal
East Coast	4·9	+ 1·9	Above normal
Central	1.3	— 0·6	Below normal
South	1·1	— 0·1	Just below normal
Hills	5·2	— 0·4	do

Agricultural Meteorology Section,
Lawley Road P. O.,
Coimbatore, 14—8—1957

C. B. M., & M. S. D.

Departmental Notifications

Gazetted Officers — Madras Agricultural Service

Appointment & Postings.

Name and present post	Posted as
Sri M. Sundaram, Lecturer in Chemistry, on the expiry of the leave	To rejoin at Agricultural College, Coimbatore.
Sri A. R. Baskaran, Uppear Subordinate in the Assistant - Agricultural Engineer's (Soil Conservation), Ootacamund.	Appointed District Agricultural Officer.
Sri V. N. Madhava Rao, Assistant Fruit Specialist (Horticulture), Coimbatore.	Posted as Assistant Fruit Specialist, (Vegetable Scheme) Vice Sri. R. Bettai Gowder (on leave).

Upper — Subordinates

Name of the Upper Subordinate Transferred	Post or Place to which Transferred
Sri T. N. Govindaswami, A. D., Tirukoilore	A. D. Ulundurpet.
,, P. Kondaswamy Chetty, Paddy Asst. Coimbatore.	Rural Extention Training Centre, Bhavanisagar, (in the new post sanctioned).
,, M. Vijayanandam, Extension Officer, Soliamangalam.	Extension Officer in Agriculture, Thirupparankundram, Madurai.
,, M. Arumugam, Extension Officer, in Agriculture, Thirupparankundram.	Extension Officer in Agriculture, Gandhigram, Rural Extension Training Centre.
,, S. R. Sreerangaswamy, Agricultural Demonstrator, Kodaikanal.	Paddy Assistant, Coimbatore, (in leave vacancy of Sri D. Meenakshisundaram).
,, V. Veeraraghavan, Agricultural Extension Officer, Valathu Block.	Extension Officer, in Agriculture, Rural Extension Training Centre.
,, P. R. Subramaniam, Plant Protection Assistant (Ento.) Madurai.	Agricultural Demonstrator, Oddanchatram.
,, B. Vasantharaj David, Agriculture Demonstrator, Oddanchatram.	Plant Protection Assistant, (Ento.) Madurai.
,, Salomon Dorairajan, Fodder and Research Assistant, Coimbatore.	Botany Assistant, Sugarcane Research Assistant, Gudiyatham.
,, D. Krishnaswamy, Botany, Assistant, Gudiyatham.	Fodder Research Assistant, Coimbatore.
,, K. R. Srinivasan, Oilseed, Development Assistant, Vellore.	Oilseed Development Assistant, Coimbatore.
,, G. Kumaraswamy, Oilseed Development Assistant, Cuddalore.	Oilseed Development Assistant, Madras.
Sri A. N. Sivapah, Oilseed Development Assistant, Madurai.	Oilseed Development Assistant, Madurai.
,, K. S. Ranganathan, Oilseed Assistant, Coimbatore.	Oilseed Development Assistant, Tanjore (New post).

UPPER-SUBORDINATES — (*Contd.*)

Name of the Upper-Subordinate Transferred	Post or Place to which Transferred
,, A. R. Viswanathan, Oilseed Assistant, Srivilliputhur, (Zonal Nucleus).	Oilseed Development Assistant, Tanjore. (New post)
,, T. A. Palaniappan, Oilseed Development Assistant, Trichy.	Oilseed Assistant, (Zonal Nucleus Scheme), Srivilliputhur.
,, S. R. Chowdappan, A. D., Coimbatore.	Special Agricultre Demomstrator, (Sugarcane), Nursery, Coimbatore.
,, D. Christadoss, Extension Officer in Agriculture, Tirumanur (Trichy Dist.)	Cane Assistant, Pandirajapuram, (Madurai Dist.).
,, M. Balasubramanian, Botony Assistant, Combatore.	Assistant Lecturer in Botony, Coimbatore.
,, N. M. Thyagarajan, Chemistry Assistant, Gur Scheme, Gudiyatham.	Assistant Lecturer in Chemistry, Coimbatore.
,, T. R. Subramaniam, Entomoloty Assistant, Coimbatore.	Assistant Lecturer in Entomology, Coimbatore.
,, M. R. Iruthayaraj, Agricultural Demonstrator, Sulur.	Agriculture Farm Manager, Sheep Breeding Station, Chinnasalem (South Arcot).
,, T. Venkatachalam, Agricultural Demonstrator, Uthukuli.	Agriculture Farm Manager, Salvege Farm, Alyadi Kambakkam, (Chingleput Dist.)
,, N. Sivaramakrishnan, Agricultural Demonstrator, Alangulam, (Tirunelveli Dist.)	Farm Manager, State Seed Farm, Omanallur, (Tirunelveli Dist)
,, D. R. Parthasarathy, (Formerly A. D.), Hosur.	Soil Conservation Assistant, Kadambuliur, (South Arcot)
,, V. Subramaniam, Formerly-Extension Officer in Agriculture, Valliyur (Tirunelveli Dist.)	Soil Conservation Assistant, Ootacamund.
,, M. V. Jayaraj, Agricultural Demonstrator, Sivaganga.	Farm Manager, District Livestock Farm, Ramnad Dist.

Horticulture Trainees.

Sri B. Chandarasekharan	Farm Manager, State Seed Farm, Salem (New post).
,, S. Kulandaswamy	Extension Officer in Agriculture, Trichy Dist.
,, Aravindaksha Menon	Farm Supervisor, Rural Extension Training Centre, T. Kallupatti, (New post).
,, V. Nagrajan	Farm Manager, State Seed Farm, Tanjore.
A. M. Mahaboob Alikhan	Farm Manager, Central Farm.
,, V. G. Mathew	Farm Manager, State Seed Farm Salem Dt. (New post)
,, K. K. Subbiah	Agricultural Demonstrator, Kodaikanal
,, R. Narashimhan	Farm Manager, State Seed Farm, (New post) Tanjore Dt.

JL
JM21, N13
N°. 44.8

Notification.

HORTICULTURE TRAINEES — (*Contd.*)

Sri P. S. Sanjeevi	Special Agricultural Demonstrator, Sugarcane, Kallakurichi, South Arcot Dt. (New post)
,, R. Thirunavukkarasu	Instructor in Agriculture, Rural Extension Training Centre, T. Kallupatti, (New post)
,, Palanivelu	Extension Officer in Agriculture, Porayar.
,, C. A. M. D. Azam	Farm Manager, Satyamangalam.
,, Achutha Kurup	Assistant to Curator, Ootacamund.
,, T. A. Sriram	Fruit Assistant, Kallar.
,, V. Balasubramaniam	Coconut Nursery Assistant, Muthupet.
,, R. S. Bhindu Madva Rao	Paddy Assistant, Pattukottai.
,, Mudappa Gowda	Paddy Assistant, Coimbatore.
Kumari B. Seemanthani	Tuber Crop Assistant, Coimbatore.
Sri C. Ramakrishnan	Entomology Assistant, Coimbatore.
,, D. Paulas, Assistant to Curator, Ooty.	Special Agricultural Demonstrator, Sugarcane, Udamalpet (Exist. Vacancy).
,, D. Rajamanickam, Coconut Nursery Assistant, Muthupet.	Agricultural Demonstrator, Arantangi.
,, R. Rajagopalan, Paddy Assistant, Pattukottai.	Extension Officer, Satyamangalam.
,, T. Gangadaran, Tuber Crop Assistant, Coimbatore.	Botony Assistant, Coimbatore.
,, K. N. Padmanabhan Nambisan, Fruit Assistant, Aduthurai.	Agricultural Demonstrator, Kuzhithurai.
,, K. S. Subramaniam, Agricultural Demonstrator, Kuzhithurai (Kanyakumari).	Cotton Assistant, Coimbatore.
,, V. Satagopan, Extension Officer in Agricultural, Sambanarkoil	Special Agricultural Demonstrator, (Sugarcane), Cuddalore (New post).
,, P. Samu Iyer, Agricultual Demonstrator, Kulitalai.	Special Agrl. Demons., Seed Nursery, Karur.
,, J. Velayutham, Agricultural Demonstrator, Nilakottai.	Special Agricultural Demonstrator, (Sugarcane), Nilakottai.
,, M. Kalimuthu, Block Development Officer, Virudunagar.	Assistant Lecturer, Coimbatore.
Srimathi L. Dhanaraj, Paddy Assistant, Palur.	Paddy Assistant, Tirur.
Sri. T. K. Gopala Rao, Paddy Assistant, Tirur.	Paddy Assistant, Tirur.
,, V. Sivasubramaniam, Cotton Assistant, Srivilliputhur.	Assistant Cotton Specialist in-charge Srivilliputhur.
,, K. A. Shanmugavelu, Agricultural, Demonstrator, Conjeepuram.	Special Agricultural Demonstrator, (Sugarcane), Mannargudi (in the post sanctioned for Sugarcane Development Scheme).

Review of the Market Conditions of Commercial Crops in the Areas of Market Committees for the Month of June, 1957.

Cotton : (In this Section : Cdy = 784 lbs.
Pothi = 280 lbs.)

Tiruppur : There were some showers here and there in this district during the month. These were helpful to the second crop of cotton of Pollachi area. This market opened with 10242 candies of Cambodia and 626 candies of Karunganni lint and 9543 candies of Cambodia and 717 candies of Karunganni lint were received which included 2525 candies of Cambodia and 53 candies of Karunganni lint locally ginned. Total despatches from Tiruppur accounted for 11394 candies of Cambodia and 927 candies of Karunganni lint which included 6347 candies sent to Bombay, Madras, Kerala, Mysore, Madurai, South Arcot, Calcutta and Tirunelveli. There was a closing stock of 839 candies of Cambodia and 416 candies of Karunganni lint.

The kapas market opened with 35493 pothis of Cambodia and 1430 pothis of Karunganni. Arrivals during the month were 17218 pothis of Cambodia and 970 pothis of Karunganni. Disposals came to 30129 pothis of Cambodia and 1475 pothis of Karunganni kapas leaving a closing stock of 22582 pothis of Cambodia and 925 pothis of Karunganni at the close of the month.

The prices of cotton kapas and lint in Tiruppur were steady but slightly weakened towards the close. The prices ranged between Rs. 920/- and 981/- per candy of Cambodia lint, Rs. 130/- and 137/- per pothi of Cambodia kapas and Rs. 115/- and 120/- per pothi of Karunganni kapas.

Ramanathapuram Market : Dry weather prevailed throughout the month, The condition of the Uganda crop is considered to be satisfactory. New crop season has commenced. The market was dull and inactive

for old crop Uganda. The Karunganni and Uganda lint market were moderately active. The three markets at Sattur, Rajapalayam and Virudhunagar put together opened with 650 pothis of kapas and 870 candies of lint at the beginning of the month. About 7800 pothis of kapas and 780 candies of lint were received. Deducting the disposals of 780 pothis of kapas and 1275 candies of lint during the month, the markets closed with 650 pothis of kapas and 375 candies of lint at the end of the month.

The opening and closing prices of cotton kapas and lint in these markets were :

Kapas	*Opening*	*Closing*
Karunganni Kapas per 280 lbs.	106 — 110	106 — 112
Tinny Karunganni ,,	90 — 105	90 — 106
Tinny ,,	92 — 98	92 — 96
Inferior Tinny ,,	75 — 90	83 — 90
Uganda ,,	—	115 — 116
Lint		
Karunganni lint per 784 lbs.	836 — 850	845 — 876
Tinny Karunganni ,,	820 — 830	830 — 840
Tinny ,,	791 — 820	786 — 816
M. U. 2 Certified Uganda per 784 lbs.	1142 --	1066 — 1076
Uncertified ,,	—	981 —
Seeds		
Karunganni seed per 82-2 7 lbs	10·80 — 11·36	11 — 11·83
Tinny ,,	12	12
Uganda ,,	—	7·83

South Arcot District : The market opened with a stock of 39 pothis of cotton kapas. Arrivals to Villupuram market amounted to 135 pothis. Despatches to Tirupur came to 147 pothis. The closing stock with the trade at the end of the month was 27 pothis. The average price for kapas was Rs. 90/-.

Groundnut : *South Arcot :* All the nine markets of the district together opened with 1700 tons of groundnut kernels. Harvest of groundnut was in progress. Local summer crop arrivals to the markets increased to 375 tons. Receipts from North Arcot, Tiruchirapalli and Tanjore districts accounted for 1507 tons besides 98 tons from Andhra. 4254 tons and 221 tons were consumed by oil mills and country chekkus respectively in the district. Despatches to other district like Salem, Tanjore, Madras, Coimbatore etc., and exports to Pondichery State came to 926 tons and 66 tons respectively. Wastage have been calculated to be 286 tons. There was a closing stock of 1327 tons with the trade at

the end of the month. The prices were steady in the first fortnight and increased in the second fortnight due to buying support from small scale crushers. The average prices in the several markets ranged from Rs. 149/- to 151 per candy of 531 lbs.

North Arcot: Though the markets were active, arrivals of groundnut were poor. Fair to moderate showers were widespread in the district. Preparatory cultivation for groundnuts was taken up on a large scale. Sowing operations are expected to be completed by the end of the next month provided some more rains are received in time. The area this year is expected to be about the same as last year, if not more.

The quantities that came into the several market centres till the middle of the second fortnight of this month were readily absorbed, as it was reported that the Calcutta and Bombay interests have renewed their buying of oil at Madras Traders. from other districts also operated in the markets.

No marked change in the prices of pods and oilcake was noticed. The prices of oil however, came down by Rs. 10/- per candy, kernels were quoted around Rs. 155 to 162/- while oil was around Rs. 320 and 330/- per candy. Pods were sold at Rs. 14/- and 18/- per bag of 80 lbs. while oil cake was quoted at Rs. 8·75/- and 9·66/- per standard Md. When compared with the same last year, kernels were sold at Rs. 163/- oil at Rs. 310/- and 330/- per candy, pods at Rs. 15/- and 21/- per bag and oil cake at Rs. 7·25/- and 8·75/-.

Ramanathapuram district: Arrivals of local crop as well as from other districts were poor during the month. The market at Virudhunagar opened with 80 tons of pods and 1060 candies of kernels and 210 tons pods and 1200 candies of kernels were received. Disposals during the month amounted to 225 tons of pods and 1045 candies of kernels leaving a closing stock of 65 tons of pods and 1215 candies of kernels at the end.

The closing prices of groundnut pods were quoted at Rs. 16/- and 18/- of 82-2 7 lbs. that of kernels at Rs. 165/- and 170/- per candy of 531 lbs. that of oil at Rs. 22·50/- and 22·75 per 35 lb. tin and that of oil cake at Rs. 8·66/- and 10/- per standard maund of 82-2 7 lbs.

Gingelly : (In this section 1 bag = 168 lbs.)

South Arcot: The opening stock with the trade stood at 493 bags. Arrivals came to 350 bags and receipts from Tiruchirapalli district amounted to 120 bags. Imports totalled to 64 bags. Crushing in mills is estimated at 142 bags and in chekkus at 590 bags. Despatches to Tanjore district amounted to 74 bags, At the end of the month the closing balance with the trade stood at 221 bags. Prices were erratic during the major portion of the month and were moving at the end. The average prices varied from Rs. 72 12 and 82 50 in the several markets depending upon the quality.

Tobacco: *Coimbatore district:* During the month 2510 candies of chewing and 125 candies of cheroot tobacco were despatched to Ramanathapuram, Kanyakumari and Tanjore districts of Madras State Quilon Trichur, Palghat and Ernakulam of Kerala State. At the end of the month under report there was a stock of 12,105 candies of chewing and 340 candies of Cheroot tobacco.

Tobacco market remained dull as in the previous month. The recent rise in the excise duty on tobacco is reported to be the reason for the present poor demand.

The prices ranged as follows :

(Per candy of 500 lbs.)

Variety	*I Grade*	*II Grade*	*III Grade*
Chewing tobacco Sun-cured:			
Meenampalayam	200 — 240	150 — 200	75 — 140
Other varieties	160 — 200	100 — 120	60 — 75
Cheroot varieties:			
Sun-cured (grown in Erode and Bhavani taluks)	200 — 300	140 — 190	80 — 120
Chewing varieties:			
Pit-cured (grown in Palladam and Sulur areas)	150 — 200	100 — 150	50 — 75

Review of Administrative Activities of Market Committees for June, 1957.

Except Coimbatore Market Committee and South Arcot Market Committee all other Market Committees are functioning under 6-A of the Act under their Revenue heads of the districts concerned. The difficulties in the way of normal working of Tirunelveli Market Committee and Ramanathapuram Market Committee continue. The elected Committee of North Arcot Market Committee has not yet been constituted. The following are the progress of licencing by the Market Committees during the month under roport :

	Section 5 (1)		*Section 5 (3)*		*Weighmen*	
	A	B	A	B	A	B
North Arcot Market Committee	72	712	41	692	26	451
South Arcot Market Committee	165	1302	93	989	83	926
Coimbatore Market Committee	75	590	76	531	53	426

A : During the month.

B : Upto end of the month from January 1957.

A meeting of the Coimbatore Market Committee was held on 12—6—57. During the month 24 samples were drawn and analysed at Virudhachalam market, out of which 22 samples contained common refraction below 4% and two samples from 4–8%. The quality of the crop marketed was as usual good.

JL
Jan 21, 1958
NS7. 44. 8

Appeal

*

You are aware that the Agricultural College and Research Institute is celebrating its GOLDEN JUBILEE this year after a successful and useful existence of FIFTY YEARS. All these fifty years, the Institute has toiled to improve crops and crop production methods resulting in increased yields benefitting the public in general. Its contribution to the agricultural welfare of the State is immeasurable and it is but proper that the event should be remembered.

The Madras Agricultural Union as a part of this great Institute has attempted during all these years to translate to the public the great work of this Institute by conducting the annual conferences and running the Madras Agricultural Journal. The funds of this organisation need strengthening to continue its useful work on a much enlarged scale in future to the agricultural masses of the State and the public in general.

We appeal to you to contribute liberally and help the great cause by sending your donations to the undersigned.

Agricultural College and
Research Institute,
Lawley Road P. O.,
Coimbatore

Secretary,
Madras Agricultural Union.

Edited and published by T. R. Narayanan, B. Sc. (Ag.), M. A. (Cantab.), for the Madras Agricultural Students' Union and printed by A. Subramaniam, at The Coimbatore Co-operative Printing Works, Ltd., Coimbatore.

2

(1)	(2)	(1)	(2)